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SELECTIONS FROM THE RECORDS  
OF THE  
MADRAS GOVERNMENT.

REPORT  
ON THE  
OPERATIONS OF THE INDIAN MINTS,

FOR THE 12 YEARS  
FROM 1841-42 TO 1852-53.

No. X. of 1855.

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# SELECTIONS FROM THE RECORDS

OF THE

## MADRAS GOVERNMENT.

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### R E P O R T

ON THE

## OPERATIONS OF THE INDIAN MINTS,


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M A D R A S :

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# INDEX.

	Page.
Letter to the Mint Committee forwarding the report,	iii
Report, ... ..	1
Memorandum A. on Unreported Fractions, ... ..	34
Do. B. on Additional Alloy, ... ..	37
Do. C. on Late Standard Rupees, ... ..	42
Do. D. on Laminating, ... ..	43
Do. E. on Checks in the Laminating Department, ...	51
Do. F. on Melting, ... ..	53
Do. G. on the Pix examination of the coins, ... ..	67
Do. H. on Milling, Bleaching and Stamping, ... ..	72
Appendix No. 1.—Statement showing the out-turn value of silver metal worked, and the losses and gains thereupon, in the Calcutta, Bombay, and Madras Mints, from 1841-42 to 1852-53.	
Do. 2.—Abstract of the results as to the experience of the Mints of Calcutta, Bombay, and Madras, from 1841-42 to 1852-53.	
Do. 3.—Statement showing the gains in the Calcutta Mint, and the rates per lac of the coins issued for the twelve years, from 1841-42 to 1852-53.	
Do. 4.—Statement showing the operative losses in the various departments of the Calcutta Mint, and the rates per lac of the coins issued, for the twelve years, from 1841-42 to 1852-53.	
Do. 5.—Statement showing the net results in the various departments of the Calcutta Mint, for the twelve years, from 1841-42 to 1852-53.	
Do. 6.—Statement showing the gains in the Bombay Mint, and the rates per lac of the coins issued for the twelve years, from 1841-42 to 1852-53.	
Do. 7.—Statement, showing the operative losses in the various departments of the Bombay Mint, and the rates per lac of the coins issued, for the twelve years, from 1841-42 to 1852-53.	

Appendix No. 8.—Statement showing the net results in the various departments of the Bombay Mint, for the twelve years, from 1841-42 to 1852-53.

- Do. 9.—Statement showing the gains in the Madras Mint and the rates per lac of the coins issued, for the twelve years, from 1841-42 to 1852-53.
- Do. 10.—Statement showing the operative losses in the various departments of the Madras Mint, and the rates per lac of the coins issued, for the twelve years, from 1841-42 to 1852-53.
- Do. 11.—Statement shewing the net results in the various departments of the Madras Mint, for the twelve years from 1841-42 to 1852-53.
- Do. 12.—Letter from Captain Burke, Bombay Mint Master.
- Do. 13.—Letter from Col. Forbes, Calcutta Mint Master.
- Do. 14.—Statement shewing the fineness of the coins issued from the Madras Mint, as per Assay Master's pix reports, for the twelve years, from 1841-42 to 1852-53.
- Do. 15.—Statement showing the losses, charges, and profits, in the Calcutta Mint, for the year 1852-53.
- Do. 16.—Pyx report of the Calcutta Mint from 1841-42 to 1846-47.
- Do. 17.—Bombay Pyx coins from 1841-42 to 1851-52.
- Do. 18.—Statement of the results of work in the Madras Mint during the 23rd settlement, viz., from 1st May 1854 to 10th January 1855.
- Do. 19.—Silver melting room account, from 1st May 1854 to 10th January 1855.
- Do. 20.—Statement shewing the number of pix assays made during the 23rd settlement, viz., from 1st May 1854 to 10th January 1855, with the calculated fineness of the coins thereupon.
- Do. 21.—Statement showing the course of work in the laminating department for the month of September 1854, and the influence of each process upon the weight of the silver subjected to its operation.
- Do. 22.—Statement of experiments made at the Bombay Mint.
- Do. 23.—Assay and out-turn report on twelve musters of drosses of the 23rd settlement, received from the Mint Master on the 9th January 1855.
- Do. 24.—Table shewing the correspondence, between the rates per lac, per mille, and per cent, in rupees, annas, and pice.

## GLOSSARY OF TECHNICAL TERMS.

*Additional Alloy.*—The copper, or other alloy put into the mixture intended to form “Standard” silver, beyond the true arithmetical proportion, in order to compensate for loss of base metal during manipulation.

*Alligation.*—The mixture of silver of various qualities melted together to form “Standard” metal.

*Anna.*—The one sixteenth part of a rupee, or of the tola weight.

*Annealing.*—The exposure of the ingots, laminated straps, or blanks, to a red heat in a reverberatory furnace, to soften and fit them for coinage.

*Assay.*—The expeditious chemical analysis, whereby the proportions of silver or gold and base metal in any compound is ascertained.

*Assay Pound.*—The weight of the sample actually submitted to experiment.

*Better.*—A term applied to silver (or gold) when it is more or less superior to the precise “Standard,” indicating that it contains a larger proportion of the precious metal.

*Betterness.*—Superiority to “Standard.”

*Blanks.*—The unfinished pieces as they are punched from the straps, previous to raising the edges, and cleaning and stamping them.

*Bleaching.*—Boiling the pieces in dilute sulphuric acid—to whiten them.

*B $\frac{1}{2}$ .*—This sign signifies that the metal or coin to which it is applied is “Better” or superior to Standard, by half a pennyweight in the pound troy, or the  $\frac{1}{480}$ th part.

*Bullion.*—Precious metal, suited for coinage, usually in the form of bars, or coins not current in the country to which the Mint belongs.

*Drosses.*—The Sweepings of the different rooms, slag and cinders from the furnaces, and earthy matters collected during coinage, which are supposed to contain silver.

*Granules.*—Finely divided particles of metal, formed by pouring it, when in a melted state, into cold water.

*Ingot.*—A flat bar of standard silver, generally about 15 inches long by  $2\frac{1}{2}$  broad, and either  $\frac{5}{8}$ th inch or one inch thick; cast in that peculiar form to facilitate lamination for coinage.

*Lac.*—One hundred thousand.



*Lamination.*—Passing the ingots and straps between a series of rolls at gradually diminishing distances apart, to reduce them to the form of straps of the proper thickness for cutting out the pieces.

*Muster.*—The small bit or sample of silver cut from a bar or ingot for assay.

*Out-turn.*—The produce of the Mint in coins.

*Oxidisable.*—Capable of being oxidised, or converted into oxide or rust, and thus having the metallic properties destroyed.

*Pix or pyx.*—Properly a box, but applied to the formal examination and test of coins by the Assay Master, or other qualified person appointed by Government.

*Pre-melting.*—The fusion of merchant's bullion, to fit it for assay and reception by the Mint.

*Refinement.*—The increase of purity or fineness, occasioned, either purposely by artificial means, or by the natural effect of the processes of manipulation in coinage.

*Scissel.*—The cuttings of standard metal (or metal very near "standard") which remain after punching out the blanks intended for coinage from the laminated straps.

*"Standard."*—The legal fineness of the coins. In India this signifies that  $\frac{3}{2} \frac{2}{4} \frac{0}{0}$ ths of the metal is pure gold, or silver.

*Straps.*—The laminated ingots when they have been brought to the thickness, or near the thickness suited for cutting out the blanks. For rupees the straps are generally about 15 feet long,  $2\frac{1}{2}$  broad, and  $\frac{1}{2} \frac{1}{8}$ th inch thick, when ready for cutting.

*Tola*—The weight of a Company's rupee—180 grains.

*Touch.*—The fineness of any metal stated decimally. Thus Indian "standard" gold or silver is 91.666 "touch."

*Trade Assay.*—This term applies to the title or report of fineness which by universal consent is made of merchant's bullion, and which specifies its fineness at the half pennyweight next *below* the fractional result shown by the assay. It is, therefore, short of the truth by the fractions which cannot be reported.

*Unreported Fractions.*—A trifling excess in fineness of bullion beyond the quality stated in the "Trade assay" report.

*Worse.*—A term applied to silver, or gold, when it is inferior in fineness to the "standard," that is, contains a larger proportion of base metal.

*Worseness.*—Inferiority to "standard."

*W $\frac{1}{2}$ .*—This sign signifies that the metal or coin to which it is applied is "worse" or inferior to "standard" by half a pennyweight in the pound troy or the  $\frac{1}{4} \frac{1}{8} \frac{0}{0}$ th part.

To

G. L. PRENDERGAST, Esq.	}	<i>Mint Committee.</i>
W. H. BAYLEY, Esq.		
S. D. BIRCH, Esq.		

GENTLEMEN,

1. Agreeably to the instructions of Government in the Minutes of Consultation of the 6th January 1854, communicated in your Secretary's letter of the 6th April, I have now the honor to forward the Report therein called for, on the results of the practice of the three Indian Mints, as to the custody and produce of the bullion entrusted to them during the twelve years from 1841-42 to 1852-53.

2. I trust that you will excuse the delay which has occurred in fulfilling these instructions, which has arisen partly in consequence of the time occupied in procuring the necessary information, the last of the papers applied for having reached this office from the Bombay Mint only on the 25th of September last, and partly owing to the diversity and complication of the many facts and calculations involved in the minute analysis of the operations of the three Mints throughout so many successive years.

3. I must also attribute to the latter cause above mentioned the additional trouble which, I fear, the perusal of my Report may cause, by the occasional repetitions, which, owing to the intimate connection of the different Mint processes I have, in my endeavour to elucidate some of the more difficult points, preferred to the risk of obscurity; but which are more numerous than they would have been, could I have commanded sufficient leisure to study the subject as a whole, free from the distraction of numerous other occupations.

4. The statements contained in the Report are almost universally taken, either from official documents already in your possession, or from the printed Reports laid before Parliament and published by its authority.

With regard to any other information, I have endeavoured in each case to quote the authority, in order that you may have independent means of verifying every important fact ; and I trust that you will in none find any serious error.

5. It is possible, however, that in spite of all my endeavours, an oversight or inconsistency may still be found here and there in the Report or its Appendices, arising from the causes\* above mentioned ; but whether this be the case or not, I trust that your Committee will see no just cause to take exception against the general accuracy of the statements and principles which I have advanced ; and which, founded as they are upon many years close observations and attentive study, are, I hope, deserving of your full confidence.

6. Your Committee will find the general results of the investigation fully stated in paras 9 and 13 of the Report, and a few general remarks connected therewith in paras 105 to 108, to the request contained in the last of which I respectfully solicit your attention, as well as to para 21, page 9.

7. You will no doubt observe, with satisfaction, that in all the Indian Mints there has been very great improvement of late years, the large losses experienced formerly having been lately replaced by gains ; thus† you will‡ perceive that during the first half of the twelve years, the losses in the three Mints (including Madras, which had a gain of 11,790 Rs.) amounted to Rupees 2,31,615, instead of a gain of 3,88,583, or a total loss of 6,20,198, at the rate of 103,366 per annum ; while during the second period of the same length, the result of the operations of all the Mints has been a gain of Rupees 18,107 (instead of a gain of 2,96,630)§ a great improvement, indeed, upon the former experience, and indicating a diminution of loss as compared with the past, of 67,446 Rupees per annum ; but less, notwithstanding, than it should have been, by Rupees 2,15,523—and thus indicating still the existence of some causes of undue wastage, and room for further improvement, to the extent of 35,920 Rupees per annum, in addition to pre-melting recoveries of the value of from 7 to 21,000 Rupees per annum more.

8. Your Committee will also observe that, with the exception of one year out of the twelve, this Mint has never exhibited a loss on its

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\* In some instances trifling discrepancies occur in consequence of the annas and pice being disregarded.

† Vide note to para 67, page 24.

‡ Para 5.

§ Vide Report, paras 31, 33, 38, and 40.

transactions ; that during the first six it realised 49 per cent of the gains which would be experienced by perfect work, during the last six 64 per cent ; and that latterly, owing to the discovery of the most obscure of the causes of loss and deficiency, and the contrivance of means of obviating them, the former losses have been entirely put an end to, and the *whole* of the surplus shown theoretically to be proper in the coinage of silver bullion has been realised. The same will, I have little doubt, be the case in the other Mints within a short period.

9. Should I have succeeded in establishing the truth of the principles which I have endeavoured to demonstrate, and should they be considered worthy of adoption by Government, I venture to hope that they may be found of more value than the mere economy resulting from them ; as they may furnish the basis for the establishment of a simple check over the important but obscure operations of the Indian Mints, and wholly relieve the Authorities from the consideration of those numerous technical details of internal management, a few of which have been given in the Report ; and which, in the aggregate, if properly and fully inquired into, may almost be compared to a science, which it takes years of experience fully to comprehend.

I have the honor to be,

Gentlemen,

Your most obedient Servant,

J. T. SMITH,

*Mint Master,*

FORT ST. GEORGE, MINT, }  
25th April, 1855. }





## R E P O R T

*On the Results obtained in reference to the custody and produce of Silver Bullion in each of the Indian Mints, prepared in conformity with the Resolution of Government, contained in Minutes of Consultation 6th January 1854, and the Instructions of the Mint Committee, under date the 6th April 1854.*

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1. The object of the present Report being to investigate more particularly the results connected with the safe custody and restoration of the bullion, a question on which there exists much difference of opinion,

Object of this Report. I myself having ventured to propose improvements in the former practice of the Indian Mints, I trust that I shall be excused if I take the liberty of referring to the principles which I have endeavoured to establish, as they will conveniently furnish a standard of comparison, and, as I trust I shall be able to show, point to a degree of success which we may in future make our aim, and which we may reasonably expect to attain to.

2. The following statements have been prepared to illustrate this subject:—Appendix No. 1, shows the experience of each of the Mints, as stated in the official records submitted by the head of the department, and Appendix No. 2, is an abstract of the same, both of them divided into

Tables referred to. two periods of the six years preceding, and the six following the publication of my views as to the results which ought to be met with in the manipulation of silver bullion, and which results are contrasted in the abstracts with the results actually recorded.

3. If we examine the first of the periods above-mentioned, viz., from 1841-42 to 1846-47 as exhibited in the abstract Appendix No. 2,

Results shown by official accounts as submitted. we perceive it to be stated that there ought to have been a gain\* by the operation of the three Mints of 227,265 Rupees, whereas the accounts rendered by the Mints show that there was a loss, during

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\* This is a true surplus value of bullion, as compared with the value charged in the accounts, and paid for to the merchants. This is not a question of profit and loss, as relates to expenses and income; but one regarding the effects of the manipulation of the precious metals, which I have ventured to affirm ought to yield an excess. The profits and losses of the Mint, by seignorage, &c., as contrasted with charges, is quite a different thing,

the six years, of 340,974 Rupees ; although they include a gain by the Madras Mint of Rupees 10,953. Had the Madras Mint exhibited a similar result to the other two, viz., a loss, which in proportion would have been 33,853 Rupees, the total losses would have been (385,780 Rupees) three hundred and eighty-five thousand, seven hundred and eighty Rupees.

4. It will be shown hereafter that the statements recorded by the Calcutta Mint required correction, to exhibit the true bullion results, as they contain entries of loss which are not losses of bullion ; and there

are also sources of gain not included in my estimate in Appendix 2, which is founded on Accounts require correction. a surplus of only one per mille on all bullion. The Bombay Mint accounts also require some correction, to fit them for comparison, as they include losses in refining, which are not properly losses in coinage, and are not equally sustained by the different Mints ; and also gains and losses by the overweight and deficiency of the coins. The statements will indeed require to be examined in minute detail, and it is probable that, if due allowance were made on both sides, the result would be, as regards the first period, not very different from that represented by the official records ; but before entering upon this investigation, I would

Importance of the new principles.

respectfully observe, that the actual gain proposed by the adoption of my principles, in preference to the former system, is represented by the difference between the loss in the above six years of 385,780 Rupees, and a gain during the same period of 227,265 ; total 613,045 Rupees. Indeed, this is not all.

5. It will be seen, upon a careful analysis, that the sum total of the gains which ought to have been realized during the first period in the three Mints, is 388,583\* Rupees, and the actual result a loss of 231,615 Rupees, being a difference of 620,198 Rupees ; but this actual result includes a gain instead of a loss by the Madras Mint, and the above contrast supposes the same system, and the same results, to obtain in all three ; in which case, assuming that the loss in Madras had been in the same

ratio to the bullion operated on as the average of the other two, it would have amounted Saving to be effected by them. 23,414 Rupees. The total losses, as corrected, would, under that supposition, have been 266,819 Rupees, and the total difference in the six years (655,402 Rs.) six hundred and fifty-five thousand, four hundred and two Rupees.

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\* Vide paras 23, 24, and 25.

6. These remarks I have been prompted to make, not only by what appears to me to be the great importance of effecting every practicable improvement in the management of the Indian Mints, but also because I feel that, were I to refrain from alluding to the statements which I long\* since officially made, I should appear to acquiesce in the virtual condemnation which has been passed upon them,† I therefore think it my duty now to state, that after nine years further experience, I am not only able to repeat these statements with fuller assurance of their accuracy, but am also of opinion, that the restrictions suggested by my wish to avoid exaggeration, may, in great measure, be removed, and even a higher standard of success aimed at than that which I prescribed.

7. As it will throw a light upon the examination now to be entered into, I will briefly recapitulate the principles above referred to. They are as follows:—

1st. That there is no loss (at least no appreciable loss) of silver, during the ordinary operations of coinage; except in the drosses.

2nd. Consequently, that if the silver remaining in the drosses be fairly and fully reckoned, the whole of the silver received by the Mint ought to be accounted for.

3rd. That as the amount of silver actually received by the Mint exceeds that registered in the accounts by the “unreported fractions,” and as by Article 1st there is no loss, these fractions ought to be delivered without diminution, and constitute an excess at the close of operations.

8. Instead of the 2nd and 3rd of the above articles, it would perhaps be more convenient hereafter to say that, as the silver may be economically extracted from the drosses, so as to leave only a very inconsiderable part therein, and as it would be practically impossible to calculate the unreported fractions within very narrow limits, and therefore a margin of uncertainty of some extent must necessarily be allowed,

the doubt being given in favor of the Mint, it follows that, assuming the Government make a moderate calculation of the produce of the unreported fractions, there is no necessity to take the silver left in the drosses into consideration;

\* In a printed memorandum forwarded by Captain Buckle on the 4th March 1846.

† No notice has been taken of the subject officially, that I am aware of, though it appears that it was referred to Bengal.

but that every Mint may be expected to deliver the silver debited against it, without waste or deficiency, and with a surplus corresponding to the calculation.

9. It will be my duty to explain hereafter to what extent these views have been realized hitherto, and to point out the causes which have created a difference between the results which I have stated to be capable of attainment and past experience; at present, it may help to remove some prejudice, if I draw attention to the fact that great improvement has already been effected in all the Mints, since the subject was first noticed; as will be seen by reference to the experience of the second

Improvement already effected. period of six years, given in the abstract Statement No. 2, as compared with the results of the first, mentioned in para 3; and I trust that as this comparison demonstrates the truth of my opinion, that considerable improvement was attainable at the time of the publication of my views, it will not be thought unreasonable in me to expect that, eventually, the full measure of success which I look for will be attained.

10. In the second period, instead of only one, two of the Mints exhibit a net gain upon all their transactions, and the third Mint has a gain in three successive years, though exhibiting a loss upon the whole;

Improvement particularized. but on investigation it is proved that this recorded loss is erroneous, and the true result is in fact a gain, thus realising a net gain by the operation of all the three Mints for the second period, instead of a loss as before.

11. Referring to the abstract of the second period in Appendix 2, your committee will observe, that the records of the Calcutta Mint show a loss of 38,205 Rupees, instead of a gain of 94,398; the Bombay Mint a gain of 22,542, instead of a gain of 81,826, and the Madras Mint a gain of 16,208, instead of a gain of 15,173; the expected gains being in all cases equally calculated at one per mille, or 100 Rupees per lac, of the bullion operated on.

Results as reported. 12. Correcting the accounts of the Calcutta Mint, as above explained, the effect is to show the bullion losses as having been less than they are represented, though the gains which ought to have been met with, and with which they are contrasted, ought also to be more than

Results as corrected. 2nd Period.

my calculation. The deduction which ought to be made from the losses shown in the abstract is not less than 87,764\* Rupees, thus showing a

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\* Vide Statment No. 5.



real gain\* instead of a loss, as recorded; while the addition to the gain which ought to have been realized is Rupees 79,555,† so that the comparison, if properly stated, would be a gain of 49,559 Rupees, instead of a gain of Rupees 173,953‡ which there ought to have been. Hence the net actual result of all the three Mints, during the second period, will hereafter be seen to be an apparent gain of 81,107§ Rupees, which is at the rate of 42 Rupees per lac of the bullion operated on, instead of an apparent loss as in the first period, in two Mints, at the rate of 117 Rupees per lac.

13. Perhaps the improvement which as taken place will be more clearly exhibited by stating that, whilst during Improvement more clearly stated. the first six years, the losses in the Calcutta Mint, reckoning as such, in all cases, both the losses actually realized and shown by the accounts, and the gains which ought to have been experienced, were 406,248|| Rupees, or 67,708 Rupees per annum,¶ during the second six years, they have been reduced to 124,394\*\* Rupees or 20,732 Rupees per annum.†† In Bombay, while the losses during the first six years were 202,008‡‡ or 33,668 Rupees per annum,§§ during the second period they fell to 84,617|||| Rupees, or 14,103 Rupees per annum. In Madras while the loss during the first six years came to 11,942¶¶ Rupees, or 1,990 Rupees per annum.\*\*\* during the last six they were reduced to 6,512††† or at the rate of 1,085 Rupees per annum.‡‡‡ Your Committee will be glad to find it shown§§§ that we have at last succeeded in extinguishing even the whole of this loss, and that there is reason to believe, that in future, the *whole* amount of gains by unreported fractions, except the value in the dross, will be realized; and I need hardly add my persuasion that the same will also be the case in the other Mints.

14. The corrections in the Calcutta statement are chiefly owing, first, to the value, or *price* paid for copper used in alligation, being put down amongst the losses of bullion, and second owing to the fact Nature of the corrections to the accounts.

\* Loss recorded....38,205a

Deduct .....87,764

Gain—49,559

† Vide Appendix No. 2, and para 31.

‡ Vide para 31.

§ Vide Appendices No. 5, 8 and 11.

a Vide Appendix No. 2.

|| Vide para 23.

\*\* Vide para 31.

†† Vide para 24.

||| 103 Rs. per lac of out-turn—vide para 33.

\*\*\* 59 Rupees per lac of out-turn.

††† 43 Rupees per lac of out-turn.

¶ 301 Rupees per lac of the issues by the Mint

†† 131 Rupees per lac of out-turn.

§§ 279 Rupees per lac of out-turn.

¶¶ Vide para 25.

††† Vide para 40.

§§§ Vide para 87 and Appendix 18.



of large values of late standard Rupees, being debited to the Mint, not at their actual assay value, minus unreported fractions, but at the nominal fineness "standard," when often above it by sometimes  $1\frac{1}{2}$ , or even 2 dwts. The subject of the value of copper is more fully remarked upon in paras 93 and 94 of this report, and that of the late standard Rupees in Memorandum C. The nature of the adjustments required by the Bombay accounts to fit them for use, has been already explained.

15. And the Madras accounts too require explanation, in reference to this comparison; for although true in themselves, they would otherwise lead to the fallacious inference, unavoidable on a hasty inspection of them, that the principles advocated by me had been fully realized and established by the results of the last six years; the surplus being even more than the anticipation; but the fact is that such has not been the case in the way it would appear, with the exception of the last year contained in the statement, (1852-53) the profits in the preceding years being increased by items of gain not connected with the actual manipulation of the bullion subsequent to receipt.

16. As I am of opinion that much benefit may result from a full and elaborate (and I fear it cannot but be tedious) examination of all the details of the practice of the three Mints, I do myself the honor to submit the accompanying three series of statements, Appendices Nos. 3 to 11, which enable me to lay before you the minute details of experience, and show the items of loss in each department of all the Mints, and also to trace the causes which have led to them,\* and I am glad, that in endeavouring

Remarks on accounts of the Madras Mint. Minute investigation desirable.

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\* These statements have been prepared in a precisely similar manner for each Mint, and so as to represent the gross apparent waste, or difference of standard weight, and its rate per lac of the *coins issued by the Mint*, for every process. In some respects it would have been more convenient to have adopted the method usually employed in the Mint statements, of representing the losses at their rate per cent, or per mille of the *bullion operated on*, but on this occasion it appeared to me to conduce so much to the perspicuity of the general comparison of results, to refer all gains and losses to one uniform standard, that I have given it the preference. It is necessary to bear this in mind in considering the apparent losses in melting and laminating, because in both of these the metal operated on is, in round numbers, about double the issues from the Mint.

With the view to greater clearness, also, I have, in setting down values, used the nearest integral Rupee, in place of inserting the annas and pie. As the rates are per lac, the fractional entries have been rendered unnecessary, and ratios of gain and loss are correctly shown which would be unintelligibly minute if they were estimated per cent, or even per mille. For the convenience of those who have been accustomed to different rates, a table has been prepared, Appendix No. 24, showing the comparison of the various rates up to 150 tolas per lac.

to point out what is still wanting in our practice, I shall be able to do so by referring to the defects of my own administration rather than that of others.

17. I propose, therefore, to analyse the operations of all the three Mints, confining my remarks chiefly to that of Madras; and before doing so, I would beg leave respectfully to warn your committee against the unfavourable impression which the statements I shall have to make will probably produce in your minds. In laying before you an undisguised representation of all our transactions during twelve years, I shall have to mention losses arising from negligence and dishonesty; but it must be remarked that, although with increased experience, and an enlarged knowledge, only acquired of late years, I am now able to look back upon our past results, and point out their deficiencies; it would be wrong to suppose that it was possible, in the absence of this knowledge, to have detected them at the time, or to have sooner placed matters upon a satisfactory footing.

Nature of the investigation stated.

18. Statements No. 3, 6, and 9 show the sources of gain in each of the Mints, and the actual benefit realized from them during the twelve years under review. They are as follows:—Unreported fractions. The nature of these, and the amount of gain caused by the unreported fractions, in the Indian Mints, is explained at length in Memorandum A, appended to this report. The actual value of them is distinctly shown in the Bombay statement No. 6, being at the rate of 119 Rupees per lack on the coins issued (which must be about equal to the bullion operated on).

Statements 3, 6, and 9 referred to.

19. There is another source of *apparent* gain, viz., the “additional alloy” put into the pots, over and above the true mixture or “alligation.” The nature and object of this addition is fully explained in Memorandum B, where it is shown that it cannot be the means of any real gain, but that it is indispensable, as the only method of avoiding a real loss.

Items of gain in Mints.

20. In the Calcutta and Madras statements, the copper put in to cover “unreported fractions” and the “additional alloy” are not shown separately. In Calcutta, in the earlier years contained in the Statement, the practice seems to have been for the Assay

Master to order “extra alloy” in one mass to cover “unreported fractions” and “additional alloy” proper; as well as a third source of real gain, peculiar to the Calcutta Mint, viz., that by melting “late standard Rupees,”\* vide Memorandum C.

21. In Madras, it has been impossible to keep separate the account of copper used to cover “unreported fractions,” and the “additional alloy” to cover refinement, owing to the disadvantage of the assay fractions not being made known. In both the other Mints, although the reports given to the importers of bullion are, as usual, made to the  $\frac{1}{2}$  dwt., the exact fractions are nevertheless ascertained, and separately communicated to the Mint. This would be a very great advantage here, but it has never been introduced; we have therefore been obliged to put in copper to cover unreported fractions and additional alloy by guessing what they ought to be, instead of a knowledge of what they were; and to follow a course of procedure which, though originally based upon principles unconnected with the essential circumstances of manipulation, was found, practically, to lead to the desired result.

The same in Madras.

#### FIRST PERIOD.

22. It will have been observed, by a perusal of the Memorandum A, B, and C, that the sources of real gain to the Mints are, as regards Calcutta, the gains by “unreported fractions” and by “late standard rupees;” in Madras and Bombay by “unreported fractions” only. In making an estimate of the value of these, during the first period of six years, in order to show precisely what the produce of the Mints should have been, it is necessary, as the unreported fractions both in the Calcutta and Madras accounts are blended into the same mass with additional alloy, to estimate their value; and therefore I shall, in what follows, calculate them in each case at the same as they are shown to be in Bombay, by actual measurement during twelve years, viz., 119† Rupees per lac of the out-turn.

Calcutta.

Calcutta.

23. According to this, the gain during the first period in Calcutta, ought to have been

\* There was also a fourth source of real gain covered by the extra alloy in the Calcutta Mint, and this was depreciation of the merchant's bullion, in order to cover the loss by dirt, instead of pre-melting; but this does not appear to have existed during the period now under review, to any great extent.

† Vide Statement, Appendix No. 6.

By late standard Rupees*.....	166,036
Unreported fractions on the other bullion, at	
119 Rupees per lac.....	118,842††
Total..	284,878

The actual result, after correcting the accounts, appears to have been a loss of 121,370.†

Bombay. 24. In Bombay, the gain arising from unreported fractions, during the first period, ought to have been 79,973.‡ The actual result was a loss of 122,035.§

Madras. 25. In Madras, the gains by unreported fractions during the first period, ought to have been 23,732,|| the actual result was a gain of 11,790.¶

26. As it will be my duty to enter more fully into the accounts of the second period, I will not now detain your Committee by any further remarks upon the preceding, than by stating, that one of the principal causes of loss appears to have been in Calcutta, and Bombay, and partially in Madras the reception of bullion, and its being debited at its gross weight, without pre-melting..

27. In Calcutta, as before noticed, a compensation for this loss was arranged and carried into effect during the time that Mr. James Prinsep was Assay Master,\*\* but it appears to have been lost sight of since.

28. Calculating the unreported fractions at the same rate in Calcutta as in Bombay (119 Rupees per lac), and deducting the amount thus obtained, viz., 118,842†† Rupees, from the whole quantity of additional alloy used during the first period (240,282)‡‡ the difference, 121,440 shows the weight of copper put in to meet refinement, or "additional alloy" proper; and comparing this with the weight of the bullion (minus the late standard Rupees, the gains by which include their own extra alloy), the ratio is  $121\frac{1}{2}$  tolas per lac. The rate in Bombay being  $120\frac{3}{4}$  tolas. Making a similar calculation for Madras, the result arrived at is an allowance for refinement of 160 tolas per lac.

\* Vide Statement No. 3, and Report para. 28.

‡ Vide Statement No. 6.

|| At 119 Rs. per lac of the out-turn.

† Vide Statement No. 5.

§ Vide Statement No. 8.

¶ Vide Statement No. 11.

\*\* Vide note to para 20.

†† That is 119 Rupees per lac upon 998.67 lacs; which is 1348.50, minus 349.83, the value of late standard Rupees melted during the period.

‡‡ Vide Statement No. 3.



29. It thus appears that a larger allowance of copper was used, during the first period, to meet the destruction of alloy in Madras, than in either Calcutta or Bombay, to the extent of 39 tolas per lac; but it must at the same time be mentioned, that in Madras the coins issued during the first period proved to be very close to the standard,\* although still above it, whereas in Calcutta and Bombay, they are considerably above it.†

30. I now come to the second period of six years, and proceed to compare the results of the different Mints in the same manner as before. Turning to the Calcutta Statements we find, that the unreported fractions began to be separately entered in 1846, and have since been continued, but the gain by the "late standard Rupees" ceases with 1848-49, and the additional alloy after 1850-51.

31. The total amount of gains from unreported fractions and late standard Rupees, irrespective of the apparent gain by additional alloy is.

Calcutta.	
Second period.	Unreported fractions,..... 146,556‡
	Late Standard Rupees,..... 27,397‡
	Total ..173,953

which sum shows the amount of surplus after manipulation there ought to have been, on an exact calculation. The actual result realized appears, after a correction§ of the accounts, to have been a gain of 49,559|| Rupees.

32. The causes of the gains being so far short of the above calculation, appear to be chiefly the omission to compensate for the loss of base metal during manipulation, the additional alloy having ceased, as above noticed, in 1851; also the absence of any excess of delivery in

\* It is important to mention that in Madras, the Mint Master is the *maker* of the coins, as to fineness, as well as other respects, and his work is tested by the local Assay Master's reports; he does not consider himself responsible for any judgment by the Royal Mint, for that the local Assay Master is answerable. In Calcutta and Bombay, the local Assay Masters are the makers of the coins as to fineness, and there is no local check, nor any at all, except the assays of the Royal Mint.

† The Calcutta coins from 1841 to 1846 inclusive, are upon an average of the pix assays, by the Royal Mint, nearly 1-10th dw. above standard, or at the rate of 41 tolas per lac. In Bombay, the coins issued during the first period, appear by the statement of pix assays appended to Captain Burke's letter, to be about at the rate of 107 tolas per lac above standard.

It must be admitted, however, that these pix reports are not absolutely conclusive tests of the out-turn value of the bullion, in order to which, they ought to be made by the *same* standard whereby the bullion is purchased and alligated, that is the local assay.

‡ Vide Appendix No. 3.

§ Vide Para 14.

|| Vide Appendix No. 5.



the laminating department. Taking an average of the whole second period, the proportion of additional alloy actually used is only at the rate of  $42\frac{1}{4}$  tolas, instead of  $121\frac{1}{2}$ ,\* as during the first period, or  $120\frac{3}{4}$  and 160 per lac, as in Bombay and Madras. Had it been continued at the rate previously adopted, and had an excess been realized in the laminating department, corresponding with what appears to be indicated by our experience, so far as it goes, the surplus standard metal after manipulation would undoubtedly have been equal to what I have above stated, viz., 173,953 Rupees; for the difference between  $42\frac{1}{4}$  tolas, and  $121\frac{1}{2}$

Calcutta. tolas of additional alloy, per lac on the whole out-turn, in the second six years, would be equal to 74,810 Rupees, and an excess of only 53 tolas per lac in the laminating department, (and it is elsewhere shown, that even more than this may be looked for,)+ would yield 50,031 Rupees; which two items, added to the gains actually realized, together amount to 174,400 Rupees.‡

33. In Bombay, during the second period, the amount of gain by unreported fractions, showing the excess of standard silver which ought to have been delivered, was 104,622;§ but the actual result was a net gain of only 20,005,|| a difference of 84,617. The reason of this surplus being short of the full amount, must be looked for in the

Amount of deficiencies, and causes of them. melting and laminating departments; in the former, the loss, though reduced from  $293\frac{3}{4}$  per lac of out-turn, which it was during the first period, to 174 per lac, is still much more than it will probably be hereafter, as I think it nearly certain that it may be brought as low, as from 75 to 100 tolas per lac of the general issues by the Mint. The latter rate within a trifle, appears as the average in the Calcutta Mint during the entire second period, and differs but little from the rate exhibited in three years, by the Madras Mint; although, as will be shortly explained, the attempt was not made in the latter to reduce the loss to the minimum.¶

34. The failure to effect the full reduction of apparent waste in melting, is no doubt owing to the same cause as formerly noticed, the reception of bullion

\* Vide para 28.

† Vide Memorandum D, paras 25 and 27.

‡ 49,559  
74,810  
50,031

174,400

§ Vide Appendix No. 6.

|| Vide Appendix No. 8.

¶ Vide paras 41 and 42.

in the crude state, the arrangements for pre-melting being still incomplete;\* when they are brought into operation, there can be little doubt that the melting loss will be brought within 100 tolas per lac of the out-turn (about 50 tolas per lac of the silver melted); had it been effected during the period under review, the loss would have been diminished by 60,641† Rupees.

Cause in laminating.

35. In laminating also there has been a loss which may hereafter be avoided, but it is not so great as it appears to be by the statement. In Calcutta and Madras no compensations‡ are made, and the statements represent the actual transfers of metal from one department of the Mint to another. In Bombay a compensation is made of  $5\frac{1}{2}$  pies per cent,\* or  $28\frac{1}{2}$  tolas per lac on all the scissel returned to the melter; and assuming the scissel to have been in the proportion of five to seven of the out-turn, this compensation must have been at the rate of  $20\frac{1}{2}$  tolas per lac of the latter: and as after making the compensation, the loss in the laminating department appears to be only eight§ tolas per lac, it is evident that, had business been transacted on the same footing as in Calcutta and Madras, there would have been an excess of  $12\frac{1}{2}$  tolas per lac.

Accounts adjusted.

36. This, however, as is shown elsewhere,|| is much less than it probably ought to be, the surplus, according to our experience, being 50 or 60 tolas per lac of out-turn by the Mint; and this improvement on the result would have more than made up the deficiency in the general results of the Bombay Mint, during the second period—thus:

Deficiency to be made good	...	..	...	84,617
Saving by reduction of melting loss to 100 tolas per lac				60,641
Do. by delivering a surplus in the laminating department of 50 tolas per lac, as above stated	...			47,574¶

Total...108,215\*\*

37. The reasonableness or otherwise of these statements as to the possible reduction of loss, will I trust be clearly shown hereafter,†† and I will only now observe, before proceeding to analyse the operations of the Madras Mint, that

Bombay. No waste.

\* Vide Capt. Burke's letter in Appendix No. 12.

† Vide Statement No. 7. The losses would have been 81,826 Rs. instead of Rs. 142,407.

‡ Vide Statement No. 7.

§ Vide Col. Forbes' letter in Appendix No. 13.

|| Memorandum D, Paras 25 and 27.

¶ A gain of 40,913 Rs. instead of a loss of 6,661.

\*\* The reason of this sum exceeding the deficiency to be made good, will be seen by referring to Capt. Burke's letter, Appendix No. 12, para 3.

†† Vide Memorandums D and F.

had they been accomplished, both the Mints of Calcutta and Bombay would have returned the whole of the silver delivered to them, *including the unreported fractions*, without any waste or deficiency. I now proceed to detail the operations of this Mint.

38. During the second period, the gains by unreported fractions in the Madras Mint, amounted to 18,055 Rupees, reckoning them, as before, at the average rate\* of the Bombay experience during the whole twelve years; and the additional alloy was 19,843, or at the rate of 131 tolas per lac.†

Taking these items together, it may be useful to notice, that the whole amount of copper, beyond the formal alligation, put into the pot in Madras, was at the rate of 250 Rupees per lac of the out-turn, while in Bombay during the same period it amounted to a rate of 252 Rupees per lac. In Madras, it will be observed, this was a falling off of 29 tolas per lac, from the former experience during the first period, of 279 per lac; in addition to which the coins which, upon

Madras. a close and full examination, proved a trifle Copper reduced in amount. above standard during the first, were a trifle below in the second period; while in Bombay the total extra alloy used was an increase of 21 tolas per lac upon former experience, viz., from 231 Rupees per lac.

39. The Madras Mint ought to have delivered a surplus equal to the whole of the unreported fractions (18,055 Rupees)‡; and this ought to have been done exclusively out of the proceeds of the silver debited to the Mint, and subject to the ordinary operations of coinage.

40. The surplus deliveries, as stated in Appendix No. 11, were 14,227 Rupees, besides the value of the drosses 2,059. Total§ 16,286, but the various sums which make up this total include surplus recoveries of silver (2,968), and values of dross (504) from the private bullion, or pre-melting department,|| also the value of dross in the refining department,

\* 119 Rupees per lac.

† Vide Statements No. 9. Total extra copper 250, minus 119 unreported fractions.

‡ Vide para 38.

§ The public records show an excess of 16,203 only, in consequence of being diminished by losses in refining to the amount of 77 tolas.

|| As the Honorable Court of Directors are stated by Capt. Burke, the Mint Master in Bombay, a to have unequivocally condemned and repudiated the practice out of which such gains are derived, it appears very necessary that I should here explain that, under the circumstances in which private bullion is melted in Madras, some gain, more or less, is absolutely unavoidable;

a Vide his letter in Appendix No. 12.

21 Rupees, which together come to 3,493 Rupees. Making the necessary correction for these items, it appears that the actual surplus delivery

Madras.

Result analysed.

by the Mint, in respect to the ordinary operations of the coinage, and exclusive of all other metal, was 12,793 Rupees; but from this must be deducted 1,250 Rupees, as the mass of coins stamped during the second period proved, on a very full examination,\* to be by that amount below "Standard." This leaves the net excess 11,543 Rupees, a sum short of the proper surplus above stated (18,055) by 6,512, the causes of which deficiency will be explained presently; I will only mention just now, that there is reason to believe that the undue losses in melting and recovery of dross amounted to about 3,062 Rupees; and in laminating to the extent of nearly 3,641, which sums added together rather more than make up the total deficiency.

41. With reference to the undue loss in melting, I must observe,

Madras.

Melting department.

that the Madras Mint labours under the disadvantage of not possessing a steam apparatus for grinding and recovering the drosses; consequently, while in other Mints the extraction of silver from the refuse can be economically carried to exhaustion,† it has in Madras been always considered advisable to stop short of that point.

42. This is the reason why, in Madras, it has been always necessary

Deficiency during the 2d period.

that the drosses should be assayed, and sold, the value proved to be left in them being credited to the Mint; and it is evident that if the system were properly carried out, the result, as regards the accounts, ought to be precisely the same as if the drosses were exhausted within the walls of the establishment.

and indeed I can hardly conceive any circumstances under which it could be obviated, if the Mint servants honestly do their duty.

At Madras, when the day's melting is over, the agents who attend to see the process are allowed to wash the charcoal used in the furnace, break up the (clay) crucibles, and remove every particle of silver they can detect; but with all the care they can take, it is quite impossible for them to avoid leaving some, which is discovered by a more elaborate and tedious process afterwards; and part which is found when the furnace is taken down and rebuilt.

It would be impossible to restore the value of silver thus recovered to the individuals to whom it might have belonged; as the recoveries are only made after very many parcels of bullion have been melted; and as such is the case, there is no alternative to bringing it to the public account; to which there can be no objection provided, as in the present case, it is separately noticed, and not made a means of covering defalcations in the melting room.

Were the Mint Master to ignore the fact of the existence of this profit, he would drive his servants to the invention of some means of illicit appropriation.

\* Vide Statement, Appendix No. 14. † By this is meant *nearly* total extraction.



43. But I am sorry to say that such was not the case during the period now under review, and it was owing to its failure that the losses in the melting department occurred which I have now to explain.

44. It is the duty of the Assay Department, as your Committee are aware, to assay or test the drosses; and the process is an easy one; being merely that of taking a sample sufficiently large to represent the whole mass, and, under proper precautions, to exhaust it; and afterwards, by simple proportion, calculate from the weight of the sample, and its produce, the value of the entire heap of refuse.

45. Your Committee will remember, with reference to the correspondence noted in the margin,\* the discovery that the duty above referred to had been very imperfectly carried out; but it may be as well that I should here state more particularly that, having on one occasion found that a heap of refuse, known to contain a considerable amount of silver, was after assay valued at a mere trifle, means were taken to have a correct assay subsequently made, when it proved that, although said to contain only 32 Rupees worth of silver, it was actually worth upwards of 500—of which more than half was subsequently taken from it, and the remainder sold; thus disclosing the fact, that the assays of the drosses were quite erroneous, and the valuation assigned by them merely nominal.†

46. It will not be very difficult to show what was the amount of the loss occasioned by the above mistakes. Had the drosses been exhausted within the Mint, it is probable the result of the meltings would have been similar to what it would be in any other Mint, where the bullion is pre-melted, and the drosses exhausted; and although it is not quite certain that this was, without exception, the case in the Calcutta Mint, during the whole period, yet as it probably was so to a considerable extent, it will be sufficient to assume that the rate of loss would be similar to what it was there, namely, about 100 tolas per lac.

47. If your Committee will take the trouble of perusing the separate Memorandum

\* 2nd April 1852, and 20th December 1852.

† My attention was first awakened, before the discovery above mentioned, by observing the fact, that the drosses sold by public auction fetched more than the assay report declared to be the whole value contained in them.



(F) on the subject of the losses in melting,\* you will there see that, under favorable circumstances, there is reason to believe the apparent loss may be even less than what is above stated ; but I do not wish to lay claim to any extraordinary result on this occasion. Having left the drosses unexhausted, the consequence must be, that the difference between the loss in the melting department, as it would have been by exhaustion and the actual loss, was the value of the silver not extracted.

48. Applying this to the period in question, we find that the difference above mentioned amounts to 4,596 Rupees. The actual apparent losses in melting having amounted to 19,768† Rupees, and the same, at the rate of 100 tolas per lac, being only 15,172 Rupees. Deducting from the 4,596 Rupees, the values which were credited by the Assay Master's reports, as being in the dross, and which amount altogether to 1,534 Rupees, we arrive at a result showing the loss sustained by the department, in consequence of the short valuations, viz., 3,062 ; which is the deficiency stated by me in para. 40, to be owing to undue losses in the melting department.

49. I trust that I may leave this part of my explanation to your Committee's judgment, and assume it to be established that, but for the errors which have been detailed, the deficiency would not have occurred ; and I have much pleasure in adding that, as I have ascertained by experiment, that the exhaustion of the drosses, though not profitable, as it would be, and as I hope it hereafter may be, with the aid of steam, is not attended with loss, I have made arrangements in future always to adopt that system ; and I think I may venture to promise that, under ordinary circumstances, the apparent loss in the melting department, will not exceed the rate of 100 tolas per lac, as compared with the out-turn of finished coins issued by the Mint. I now proceed to the other deficiency of about 3,641‡ in the laminating department.

50. I am sorry to be obliged on this point to state that, to the best of my judgment, after an attentive study of the subject, no other explanation can be given of this deficiency, than that it represents the aggregate of the daily petty pilferings in the laminating department, during the six years under review.

Laminating department, deficiency in second period.

Madras.

\* Memorandum F, Para 44.

† Vide Statement, No. 10.

‡ Vide para 65.

51. The subject has had my close attention for some years, and has been the cause of a gradually increasing strictness in the checks in that

Owing to peculation.

department, as the evidence of peculation became more and more apparent, though all along resisted by precautions which seemed to render it impracticable. When, however, the fact of the existence of robbery was proved, by the discovery of silver in the possession of some of the servants of the laminating department, through the agency of the police, I was led to the conviction that the precautions then in force could only have been evaded by the parties swallowing the pieces, and prevention seemed to be hopeless. At last, I fortunately thought of a simple expedient, in the way of a check, which had not hitherto been adopted, and which on trial has proved completely successful. But for this, I believe we should have been obliged to give way to the evil, as being quite beyond our means of remedy.

52. That your Committee may be able to form your own judgment

Madras.

as to the grounds upon which I at first suspected, and have afterwards ventured to estimate the amount of loss in this department, I have drawn up for your information the separate Memorandum marked

Memorandum D, referred to.

D, in which I have mentioned the experiments which have proved and measured the amount of the excess occasioned by annealing the ingots and straps, and the losses caused by laminating and cutting out; and it is proper that in this place I should explain that, although with the information now brought to bear upon the subject,

Reason why peculation was not sooner discovered.

it may appear wonderful that the discovery should not have been earlier made, yet that, in the absence of the assurance derived from repeated experiments, the fact of so large an excess being practically due to the operations of the department was altogether unknown; and even the necessity for any surplus was but obscurely indicated, and matter of great doubt, at least in this Mint.

53. To account for this, I must request your Committee's attention to the fact, that the statements of the Calcutta Mint up to 1847, clearly

Madras.

showed a loss in this department, of  $34\frac{1}{2}$  tolas per lac.\* The experience of Bombay, as far as it was known, was understood to be a loss also, the compensation having been for the first time disclosed in Captain Burke's letter given in the Appendix

Not suspected elsewhere.

\* Vide Appendix No. 4.

No. 12. In the Royal Mint also, in the coinage of gold, respecting which it is well known the utmost care is taken, it is stated in Sir Jasper Atkinson's evidence before the Royal Mint Commission in 1848,\* that there was "waste in every department," and that when the deficiency

Results in Royal Mint. did not exceed £700 on a million sterling, they considered there was not much speculation.

This corresponds with a loss of 70 tolas per lac, for all the processes subsequent to melting; and as you will observe the milling, bleaching, and stamping, in this Mint, on average of the whole twelve years, only show a loss of 62† tolas, it follows that a deficiency of eight tolas per lac in the laminating, cutting, and adjusting rooms, would have placed our experience on as favorable a footing as that of the Royal Mint.

54. It ought to be mentioned also, as a further reason for our not having sooner discovered and eradicated this evil, that the system formerly

Delay in adjusting accounts. ly in force, of deferring the balance of accounts in each department till the half-yearly settle-

ment, greatly hindered any effective control of the operations. Nothing could be known till, at the end of six months, the drosses were recovered and the accounts made up; and then, when an unsatisfactory result was obtained, there seemed to be no cause to which to attribute it, as the precautions appeared to be perfect. All that could be done was to resolve upon increased watchfulness in future.

55. In 1850, a daily scrutiny of the results was established, but

Remedies adopted. even this was ineffectual. In 1855, a close examination and daily report of the quantity

of bullion annealed, and the influence of this operation upon the balance received and delivered, effected a considerable improvement; and this led the way to the final adoption of the system now in force, by which I am inclined to hope that speculation, even by swallowing the pieces, has been put a stop to.

56. The particulars of the present system are detailed in the Me-

Memorandum referred to. morandum E, and it is only necessary here to remark in connection with it, that during the

few months since its establishment, the results of the department have been so consistent and uniform, that I feel pretty sure they may be depended upon as correct; as they record experience which has been the subject of close daily scrutiny for weeks and months, almost years together.

\* Minutes, p. 141, Art. 244 & 186.

† Vide Statement No. 10.



57. While, however, it is my duty to state what the results are, according to the routine and practice followed Experience of Madras not necessarily applicable to other Mints. in this Mint, and which is minutely detailed in the Memorandums above referred to, I wish carefully to guard against being supposed to declare that the same must necessarily be experienced elsewhere.

58. I have no doubt that, when all the processes of any Mint are minutely analysed, the result will be found to be, that the surplus in some departments will compensate for the apparent losses in others ; and thus that, with the exception of the silver left in the drosses, there will be no actual wastage of precious metal. But in the laminating, as well as other processes, I am aware that there are so many What results ought to be. apparently trifling circumstances which may alter the result, that I would merely wish in regard to this and other facts stated in this report, to be understood as recording the experience we have gained here, as a means of inviting the attention of others to the subject.

59. From our experience it appears to be established, that when ingots of the thickness of  $\frac{3}{4}$ th inch are used, and undergo two annealings, the excess in the out-turn of the Department, after laminating (including fine rolling), cutting, and second cutting for adjustment, ought to be at least 15 to 20 tolas per lac of the bullion worked, or from 30 to 40 per lac of the out-turn\* by the Mint. When large ingots of an inch thickness, which require a triple annealing, are in use, the excess appears to be not less than from 25 to 30 tolas per lac of the bullion worked, or from 50 to 60† on the general out-turn. The precise ratio of excess will vary with the greater or less proportion of small coins fabricated during the period.

60. As these results differ from the experience recorded in other Mints, as it would not be difficult to create a fallacious appearance of them, by unintentional carelessness, it may be well for me to mention, that attention has always been paid to the necessity of preventing oil from touching the straps in the course of work. No such thing is used in laminating or finishing, and the cutting presses are kept as clean as possible ; besides which, although the notice of these precautions may be satisfactory, it must be observed that the neglect of them is proved not to have occurred, by the

\* Vide Memorandum D, para 12.

† Memorandum D, paras 16, 22, 23 and 24.

detailed results given in appendix E, where the cause of excess is distinctly shown to be the annealing, and that only ; all the other processes being attended with a loss, made good indeed, eventually, in great measure, by recoveries from the sweepings.

61. It must also be particularly noticed that, if the surplus above mentioned had been caused by oil, it would have occasioned an increased waste in bleaching the pieces, which was not experienced ; on the contrary, if we compare the year 1852-53, when the excess in the laminating, cutting, and adjusting departments was restored to 37 tolas per lac, with former years, in regard to the apparent waste in bleaching, it will be seen that there was no increase ; the apparent waste by bleaching in 1852-53 being at the rate of 50 tolas per lac, which is below the average of the whole period of 62\* tolas per lac.

62. The further results obtained in regard to the  $\frac{5}{8}$ th inch ingots, since the latest of the years contained in the statement, agree with those recorded in para 59. During the last eight months of 1854, we had an opportunity of working with ingots of the thicker description ; and the experience has been as I have stated above, or, in fact, somewhat in excess of 60 tolas per lac of the coins stamped and issued by the Mint.

63. If your Committee will be so good as to examine the fourth column of Statement No. 10, you will perceive that for the first six years the experience in the laminating department of this Mint fluctuated from a surplus of from 15 to 34 tolas per lac of the out-turn (exclusive of the first year, when results cannot be quite certainly depended on), the falling off having taken place when the amount of work was reduced in 1848, a fact corresponding with the experience of the Royal Mint,† and indicative of systematic petty peculation.

64. Your Committee will also observe that, with the introduction of new measures of check, partially established in 1852, and only finally brought into full effect in June 1854, the former experience with the smaller ingots has been again realised, to as great an extent as ever previously ; though whether to the utmost extent, cannot be told,

\* In subsequent years the loss in bleaching has been increased, and especially when the thicker ingots were used ; but this has been proved, by the actual recoveries, to be owing to the separation of a larger quantity of copper from the coins.

† Vide Royal Mint Commission Report, (1848), Art. 244, p. 141.



till we have had sufficient trial with these ingots under the existing system, which has hitherto been in force only while the 1-inch ingots were being worked.

65. The facts which have been ascertained and recorded in Memorandum D, and to which I have alluded above, appear to me to justify the inference I have drawn, that the falling off in the results of the laminating department, during the Second period, is to be attributed to speculation; and that, were the work to be done over again, the surplus realised would have been at the rate of at least 38 tolas per lac, which is proved to be due to the use of  $\frac{3}{4}$ th inch ingots. If we then calculate what the difference in amount is, between the results as recorded, and a surplus at the rate of 38 tolas per lac, we find it comes to 24 tolas per lac on 151.73 lacs, or Rupees 3,641, which corresponds with the sum stated in para 40, as the undue loss in the laminating department. This sum, added to that arrived at in para 48, (3,062), as undue loss in the melting department, gives a total of 6,703\* Rupees, rather more than the whole deficiency to be explained.

66. Having thus endeavoured, to the best of my ability, to explain the causes, and estimate the amount of the undue losses which have occurred during the period under review in this Mint, it only remains for me to point out that, on adding these sums to the actual surplus deliveries,† exclusively derived from the coinage, which, after deducting the deficiency in fineness of the coins, was before shown to be 11,543, the total amount becomes 18,246 Rupees; which, by a trifle, exceeds the value of the unreported fractions estimated for the period, or the amount which, as I have above remarked, ought to have been delivered as surplus‡ by a Mint working without any fault whatsoever.

67. In closing this general review of the experience of all the Mints during the Second period of six years, I need not repeat that a very great improvement over the experience of the First period is therein manifested,§ but it will be also obvious that there is still much room for further reform. That such will be carried into effect I have not the least

\* Vide paras 48 and 49.

† 12, 793. Vide para 40.

‡ Vide para 39.

§ Vide paras 12 and 13. The aggregate surplus during the last six years is at the rate of 42 Rupees per lac, instead of 119, leaving a difference of 77 besides "late standard Rupees," and pre-melting room gains still to be realised. In para 13 these results, although showing an actual gain, are spoken of as losses; inasmuch as the whole amount of gain is not realised, the deficiency therefrom being reckoned as loss.

doubt, and I feel sure that I may safely predict, that the time is not far distant when losses in coining will cease to occupy the prominent place in Mint accounts they have hitherto held; and when every Mint will return the silver entrusted to it, including unreported fractions, without waste or deficiency, the trifle left in the dross being hardly appreciable.

Madras in 1852-53.

In that case the united *surplus* deliveries of the three Indian Mints will probably amount to not less than 50,000 Rupees per annum.

MADRAS, 1852-53.

68. I must now ask your Committee's indulgence, while I make a more particular examination of the last year contained in the Madras Statements; because Examination of the year 1852-53, proposed.

I consider that our operations during that year exhibit the actual realisation, on a large scale, of the views and principles which I have endeavoured to advocate; and I trust that it will be admitted that such evidence is conclusive, inasmuch as the single achievement of such a result, for ever demonstrates its possibility.

69. I must premise by stating, for the information of those who may not be acquainted with our system of practice, that, on the occasion of our half-yearly settlement, when the silver has been recovered from the drosses, at as great an extent as may be deemed advisable, the latter are removed outside of the walls of the establishment, to be sold by public auction; and all the silver recovered from the drosses, together with the whole balance in the Mint, is produced before one or more members of the Mint Committee, who personally check the weight of the individual bars, by actual weighing, and comparison with the register. The balance thus verified is afterwards compared with the accounts. Statement of precautions observed in settlements.

70. The new settlement, therefore, begins with all the rooms thoroughly cleared of silver; and each department commences a new series of accounts, at the debit of which all the bullion handed over to it is placed. There is no confusion of new and old accounts, and the result of each settlement is entirely distinct from all former ones.

Madras 1152-53.

71. In regard to the gains during the year 1852-53, now to be examined, and which consisted of two half-yearly settlements, it will be observed, by inspection of Statement No. 9, that they were by no means larger than usual; the whole amount of copper put into the

Gains there should have been in 1852-53.

pot, beyond the formal alligation, was at the rate of 252 tolas per lac, which is two tolas above the average of the second period,\* but twenty-seven tolas below the average of the first period, and more than fourteen tolas below the general average of the twelve\* years.

72. I point attention to the above mentioned circumstance, lest it should be supposed that the successful result to which I lay claim was attributable to unusual advantages gained by the assay. So far from this

being the case, the contrary is the fact; for Copper used less than average. while, during former periods, the additional copper used generally proved to be short of the whole quantity required to keep the coinage to exact standard, and the pieces, on a very full examination, were almost always found a little above it, it happened during this year that a more than usual depreciation of the coinage was found to have taken place; calculated at 1,204 Rupees, on a coinage of 39 lacs; and as this depreciation is reckoned as short delivery, the effect is to neutralize the gain derived by the use of part of the copper; so that, the rate of depreciation being ( $\frac{1\frac{2}{3}0\frac{4}{3}}{3\frac{9}{3}3\frac{4}{3}}$  or  $30\frac{1}{2}$  tolas per lac, the influence upon the accounts of the department is precisely the same as if the additional copper, including unreported fractions, had been used only to the extent of  $221\frac{1}{2}$  tolas per lac, (instead of 252 as stated in para 71), and the coins had proved to be standard; and it will be at once seen, on looking at former years, in column 2 of Statement 9, that  $221\frac{1}{2}$  tolas is far below the average of our experience, which amounts to 250, during the second period.

73. The whole amount of bullion operated on during the year 1852-53, was nearly 40 lacs, (39,35,171), and the actual excess of delivery in weight of coins was 6,257 tolas; and of silver contained in the dross, as per Assay Master's report, 886. Total surplus deliveries, 7,143 Madras. Actual result stated. Rupees. But of this amount, silver to the value of 1,348, was obtained from the drosses of Merchants' bullion, in the *pre-melting* department; and 1,204 Rupees represents the deficiency in fineness of the coins below true "Standard." Consequently, deducting both these items from the total surplus deliveries above-stated, (7,143) there remains 4,591, as the net surplus produce of true standard silver from the bullion, by unreported fractions, or at the rate of  $116\frac{1}{2}$  tolas per lac; which, under the circumstances above explained, of the accounts including so much less gain than usual† by additional copper, under

\* Vide Statement, Appendix No. 9.

† Viz. only  $221\frac{1}{2}$  tolas per lac, after deducting the sundry gains and depreciation, both of which are deducted from the out-turn, instead of 266, the Madras average for twelve years, or 242, that of Bombay during the same period.



both heads, is even more than the unreported fractions could have been reasonably calculated to amount to.

74. Indeed, if we calculate the “refinement,” or the copper separated during the operations of coinage, at the average Bombay rate (123 per lac), and add thereto the depreciation above stated ( $30\frac{1}{2}$  tolas), total  $153\frac{1}{2}$  tolas, none of which could have supplied the lack of the unreported fractions, and then deduct this from 252,\* the total amount of extra copper put into the pot, we find that the unreported

fractions could only have absorbed copper at the rate of  $98\frac{1}{2}$  tolas per lac; so that, according to that calculation, the surplus deliveries, which amount to  $116\frac{1}{2}$  tolas per lac, would appear to be *more* than the fractions by 18 tolas per lac.

Remarks on the results.

75. The above discrepancy is probably owing, either to the refinement having been actually less than the Bombay average, or, possibly, to the silver remaining in the dross being too highly estimated; but, whatever the explanation may be, I trust it will be obvious that the experienced result leaves no room for the supposition of any material waste of the precious metal during coinage.

#### MADRAS, 23RD SETTLEMENT.

76. Whatever difficulty there may be in comprehending the full significance of the proof contained in the foregoing statement, as to the non-existence of any waste of the silver submitted to coinage,

Examination of the recent,  
23rd settlement.

I trust that it is impossible that any should be felt in the details which I shall now proceed to lay before you, of the results of the 23rd settlement, which have been realised since the foregoing was written; and which, being the first in which the lately adopted checks and facilities

for the prevention of fraud have been brought into use, is accordingly complete in its demonstration of the undiminished preservation of the metal; and this, fortunately, at a time when a more than usual proportion of the smaller coins has been manufactured,† a fact which must make the evidence the more satisfactory and convincing.

Success stated to be complete.

77. The particulars which I have now the honor to submit are results realised under my own close personal observation, and thus possess

Precautions stated,

an amount of authenticity over and above their correspondence with the public accounts, the balance of which, as you are aware, has been verified, and the ac-

\* Vide Statement No. 9.

† Vide Memorandum D, para 24.



counts submitted to your scrutiny in a separate form ; I have therefore much confidence in soliciting your most attentive examination of them ; because, as they have been the fruit of much care and attention on the part of the officers and servants of the establishment, the facts they present may be depended upon, and I trust that you will find they exhibit the transactions and influences of the manipulation in a manner both instructive and interesting.

Madras, 23rd settlement.

78. Let me here refer to Appendix No. 18, in which the details now to be stated will be found set forth in a more perspicuous form.

Results of 23rd settlements stated.

It will there be seen, that the whole amount of bullion operated on, that is, the difference between the standard value at the "trade assay" of all the bullion received at the beginning and during the settlement, and delivered at its close, was 21,07,544, while the true standard value of the coins stamped by the Mint out of the same was 21,10,357, thus showing an excess of 2,813 Rupees, or at the rate of 133 Rupees per lac on the value of the out-turn.

79. The statement shows exactly, in every particular, how the above gain was realised ; and first, it appears that part of it, amounting to 223 Rupees, was a surplus unconnected with the proper transactions of the coinage, being composed of recoveries made in the merchants' bullion, or pre-melting department. Deducting this sum, therefore, the remainder, or 2,590 Rupees, is the net surplus arising from the conversion of the bullion into true standard coins, and this is at the rate of 123 Rupees per lac of the out-turn.

Results analysed.

80. This surplus arises from the unreported fractions,\* which it is shown were not quite fully developed by the additional copper put into the pot, the refinement by loss of copper having been rather more than was anticipated. The total amount of additional copper used, was 5,253 tolas, sufficient to cover both unreported fractions, at the rate of 127 tolas per lac, which amounted to 2,676 tolas, and refinement or waste of copper to the extent of 2,577 tolas, or 122 tolas per lac : but the additional copper put in was found to have been 208 tolas, or nearly 10 tolas per lac, short of the proper quantity, the coins proving to be superior to standard to that extent.† So that, viewing the matter in another light, we may say that, after making up

Nature of surplus, and causes of it.

\* Vide Memorandum A.

† Vide Appendix No. 20.  
d

Madras 23rd Settlement, for the loss of base metal, which took place to the extent of 2,577 tolas, the remaining additional copper was insufficient to alloy all the unreported fractions of fine silver, which thus were left in part unalloyed, and the metal accordingly above "Standard."

81. The amount of copper lost in bleaching, was ascertained by actual recovery of the metal, in a solid form, from the bleaching liquid; and this amounted to 1,532 tolas, out of a total loss of 2,037. Of this apparent loss 21 tolas consisted of silver left in the drosses, the remaining 484 tolas loss in bleaching, consisted of the oxygen and dirt brought with the coins from the laminating department.\*

82. The total excess of deliveries by the laminating Department amounted to 1,400 tolas, besides 35 tolas silver in the dross; total 1,435; of which 484, as just mentioned, represented the dirt and oxygen attached to the blanks. The remaining 951, consequently, indicates the same causes of excess of weight in the scissel,† which was one of the causes of loss in melting. Another cause of loss in melting was silver left in the drosses to the value of 238 Rupees; and if, from the total losses in melting (2,234), the 951 and 238 be deducted, the remainder 1,045 shows the loss of copper separated during fusion;‡ which amount, added to the loss of copper before mentioned, as

* Total apparent loss	... 2037	† Excess in laminating department delivered	... .. 1400
Composed as follows:		Silver in the Dross as per Assay	
Silver left in the dross as per Assay	Master's report .. 21	Master's report	.. .. 35
Copper removed in bleaching,	1532	Total..	1435
Oxygen and dirt on the blanks	.. .. 484	Composed as follows:	
	2037	Oxygen and dirt attached to the blanks	.. .. 484
		Do. do. do. to the scissel	.. 951
		Total..	1435
‡ Total loss in melting	.. .. 2234		
Composed as follows:			
Silver left in the drosses as per Assay	Master's report, 238		
Oxygen and dirt attached to the scissel,	.. .. 951		
Copper separated during fusion,	.. .. 1045		
	Total..	2234	

having been ascertained to take place in bleaching (1,532), makes up 2,577, the total loss of copper by the operation of coinage.

83. We may arrive at this same result otherwise, and more simply,

Otherwise stated.

thus—In the melting department there was an apparent loss of 2,234 tolas. In the laminating, cutting and adjusting (combined) a surplus of 1,400 tolas. In the milling, bleaching, and stamping (combined) a loss 2,037 tolas. Deducting the gain from the losses, the net difference of weight, between the bullion put into the melting pot and the finished coins, was 2,871 tolas of which 294 was the value of silver left in the drosses, and the remainder 2,577 is the amount of copper mentioned at the close of last para.

Madras 23rd Settlement.

84. I trust it will appear clear, from what has been said in para 80 that, in consequence of the insufficiency of additional alloy, which was used to the extent of 249 tolas per lac, the unreported fractions, which amounted to more than the average, were not reduced to standard. Judging by the pix assays, it would have taken 208 tolas more, to have brought the coins to precise accuracy in fineness. In that case the total amount of additional alloy would have been 5,461 tolas, or at the rate of 259 tolas per lac; thus proving the unreported fractions to be at the rate of 137\* tolas per lac.

Additional alloy insufficient.

85. The general result of the settlement is this, that, if we judge

General results of 23rd settlement.

of the gross weight of the bullion only, considering the additional copper (5,253) as an offset against apparent loss, which is shown in para 83 to amount to 2,871 tolas, a gain was experienced of 2,382 tolas, or 113 per lac; but if we look to the silver only, and compare the standard weights received and delivered, the excess is increased by 208 tolas, and becomes 2,590, or 123 per lac of the outturn.†

Amount of gain stated.

86. This is a larger proportion of unreported fractions than the

Unreported fractions.

average, and it has still to be increased by the quantity representing the silver actually left in the drosses which, by the Assay Master's examination,‡ contained

\* Vide para 80.

† It may be well to explain that para 78 shows the excess (133 per lac) including recoveries in the pre-melting department, but without the value of the coinage drosses. Deducting the former, which come to 10 per lac, and adding the latter (14) the true *coinage* excess is 237 per lac, the same as is shown otherwise in paras 80, 84, and 86.

‡ Vide Appendix No. 23.

294 tolas, or at the rate of 14 tolas per lac ; which would raise the unreported fractions to 137 per lac.

87. I trust your Committee will be quite satisfied from the details given throughout this report, and more particularly those of the 23rd settlement just concluded, that in so far as trustworthy evidence can be collected to bear upon the question, nothing can be more clear than the truth which I so long ago thought sufficiently established, but which I believe has been hitherto considered a fallacy, viz., that there ought not to be, and in fact, is not, any unavoidable loss of silver during the ordinary operations of coinage, except the quantity left in the drosses.

Madras, 23rd settlement.  
Proof that there is no waste in manipulation.

88. I can only say, in addition, that, after the most attentive study of the subject for many years, and a very careful scrutiny of the facts now laid before you, I am not myself aware of a single circumstance to weaken the force of the proof afforded by them ; and that in preparing them for record, I have endeavoured to collect and represent all the details with unbiassed impartiality, and with the utmost precision of which I am capable.

No drawback known.

89. The accordance of the late results is indeed so remarkable, that I think it necessary to remind you, that the various operative departments of the Mint are divided into distinct branches, and under the control of separate officers none of whom, in preparing their records of results, have the least knowledge of the manner in which they are to be combined together ; and they are to this moment ignorant of the degree of accuracy with which they tally in their explanation of one another.

Madras 23rd settlement.  
Proof obtained without cognizance of agents.

90. Having thus completed the examination of the latest practice in this Mint, and I trust proved, that, during certain periods at least, there was actually not the least appreciable deficiency or waste of the precious metal, I beg now to draw your attention to the practice in the Calcutta Mint, for 1852-53, with a view of shewing, in a few words, how it has happened that the results which, upon the principles I have endeavoured to establish, seem to be easily realisable, have not hitherto been experienced there.

Examination of Calcutta accounts of 1852-53 proposed.

#### CALCUTTA, 1852-53.

91. First, in reference to the gain, I beg to observe, that the only



Calcutta 1852-53. item of gain in the year 1852-53 is “unreported fractions” to the amount of 34,706 Rs. Gains there ought to be. there being *no* late Standard Rupees recoined.

92. These 34,706 Rupees of fractions ought to remain as a surplus after manipulation, but instead of this, a loss Result as stated. is recorded in the accounts of 30,285 Rupees—a difference of 64,991 Rupees. Now, not to dwell on smaller sums, it will be seen on examining the accounts,\* that this large loss is chiefly composed of the following items:—

	Rs.
Result analysed.	
1. Value of copper used as alloy.....	12,999
2. Loss in melting.....	28,560
3. Do. in melting Government remittances.....	4,581
4. Do. in milling, annealing, and stamping.....	18,374
Total.....	64,514

93. The first of these items it will, I think, be quite evident, on a little consideration, ought not to appear in the *bullion* account, as a loss. Such an item does not properly belong to a strict *bullion* account, and its insertion tends to cause an error in the conclusion to which the account leads.

94. The value paid for the copper is only a loss in the same sense as the value paid for the coals used in the steam engines is a loss; it is not a loss of *bullion*, or even of copper; because the copper itself is already entered in the *bullion* account, and its loss is reckoned together with the losses of the standard metal in which it is embodied, and of which it forms an undistinguishable part. As one of the expenses of the Mint, doubtless, the price paid for the copper alloy ought to be entered in its proper place, with the other contingent charges; but, being a *money* charge, it seems clear that it ought not to be mixed up in the entries of the weights of *bullion* received and delivered; which, but as a matter of convenience, might have been kept in lbs., oz., and dwts. troy, instead of tolas, annas, and pice; in which case, the confusion caused by the insertion of money payments amongst the entries of the apparent losses of *bullion* would be rendered impossible.

95. In a similar manner, the accounts occasionally contain entries of gains, such as, fees for *bullion* withdrawn, Erroneous entries in the accounts. gain by *refinage* charges, &c., which appear to have no connection with the *bullion* state-

\* Vide Appendix No. 15.

ments, and the introduction of which renders them unfit for the purposes of this examination.

96. In the statements which accompany this report these items have been separated, as far as possible; but in some cases the true nature of the entries cannot be positively decided at a distance.

97. The next item of loss (No. 2 of para 92) is that in melting, viz., Rupees 28,560. I trust it will be clear from the preceding part of this report, and the separate Memorandum F, on the subject of melting, that the apparent losses caused by that process arise principally from two sources, viz., 1st, the separation of base metals, or refinement of the metal in fusion, and 2nd, the loss of the weight of oxygen and dirt attached to the scissel; also that these apparent losses are compensated, and prevented from becoming real—the first by additional alloy; the second, which is dirt and oxygen added to the bullion in the laminating department, by the excess of weight delivered by that department.

98. The excess just referred to, I have in a previous para (59), and the separate Memorandum, D,\* shown to be by our experiments with 1-inch ingots, at the rate of from 50 to 60 tolas per lac of the coins issued by the Mint. As, however, our experience rests only on the basis of eight months' work, and an issue of 21 lacs of Rupees during that time, we may, to avoid the risk of exaggeration, assume that probably, under ordinary circumstances, not less than 50 tolas per lac, (that is, 25 tolas per lac of the bullion worked) ought to be delivered; and applying this in the present instance, the surplus delivery would have been 13,683 Rupees, about half of which would be in the scissel, and half in the coins.

99. I must here break the thread of this inquiry to say that, as precisely the same explanations apply to the fourth of the great losses mentioned in para 92, viz., that in milling, annealing and stamping, including bleaching, (18,374 Rupees), which is caused, part by oxygen and dirt on the coins, and part by separation of copper; and as the compensation for it by additional alloy, is mixed up with that for the melting loss, it will be convenient to take them both together for the rest of the explanation.

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\* Para 24.

100. The 13,683\* Rupees surplus delivery by the laminating department, covers losses of about equal value in the bleaching and melting departments, 6,841½ Rupees in each. The remaining losses in both, viz., in melting 21,718½, and in bleaching 11,532½

Surplus in laminating how disposed of.

are produced by the same cause, namely, the “refinement,” or separation of base metal, which it is very clear ought to be met by the introduction of additional alloy, expressly intended to prevent the alteration of the “standard,” by the separation of the base metal; and also the consequent heavy loss, as well as error occasioned thereby.

101. The sum of the two items last mentioned, is 33,251, and if we calculate the refinement during manipulation, at the average rate at

Proof that the loss in question is due to refinement.

which it has been experienced in Bombay during the twelve years, viz., 123 tolas per lac of out-turn, we find it amounts (on a coinage of 273½ lacs) to 33,660 Rupees; thus showing that it is precisely the want of the additional alloy to that extent which caused the losses in question. If again, we examine the state of the coins issued from

Do, from the coins.

the Mint during the same period, we find further proof to the same effect.† The omission has probably arisen from inattention to the fact, that the copper put into alligat the unreported fractions, only brings the whole mass into

Error accounted for.

*exact* standard; and that the use of additional alloy is absolutely indispensable, to compensate the diminution of that mass, by the separation of the copper, and the consequent variation from the “standard.”

102. The only remaining item of the heavier losses mentioned in

Item No. 3 inquired into.

para 92 is No. 3, occasioned by melting Government remittances (4,581 Rupees). This probably is no real loss, but merely expresses the weight of the dirt which was attached to coins debited at their gross weight, as silver delivered to the Mint. If so, it may be well to remark, that nothing is gained by first crediting the public accounts with dirt, as silver, and secondly, writing it against the Mint as waste; so that, as no real gain is caused by the practice, it would be very desirable if it could be discontinued; which is of the more importance, as the existence of it precludes the possibility of exactness in the Mint practice.

103. From the above inquiry, it appears, that of the whole sum of 64,514 Rupees which constitute the chief losses of the Calcutta Mint

\* Vide para 98.

† Vide Memorandum B, para 10, and Appendix No. 16.

Melting..	28,560
Bleaching	18,374
	<hr/>
	46,934

Summary of the losses of 1852-53.

together to 17,580 Rupees, are merely apparent losses, which may be got rid of in future, by alteration of the practice, and of the method of keeping the accounts.

After remedying errors there would be no waste.

104. I have only to add to these remarks that, had the practice of the Calcutta Mint throughout the years 1852-53 been such as I have endeavoured to explain and advocate, the result arrived at on its close, would have been the realisation of a surplus of Rupees 34,638\* that is, in other words, the delivery of all the bullion intrusted to it, including the unreported fractions, without waste or deficiency.

105. In concluding this report, in which I trust I may be permitted to express a hope that sufficient proof has been adduced in support of my assertion, that the large losses, formerly experienced on all our Indian Mints, were not only unnecessary, but capable of being replaced by very considerable gains, I cannot refrain from noticing the doubt naturally suggesting the inquiry how it could be possible that, if true, the fact could so long have escaped the observation of every Officer hitherto employed in this department of the public service, one numbering so many of the highest ability, and of unquestionable integrity and zeal; a doubt which probably explains the neglect of my representations, before alluded to. I would reply to the inquiry by saying that, amongst other reasons, an influential one appears to me to be the very defective state of the constitution and regulations of the different Mints, which, with much show of a merely nominal responsibility, are very deficient as to any vital check, so that they contain no principle capable of pointing out defects, and stimulating investigation; added to which is the want of an effective supervision of the accounts by parties competent to understand them.

Why this Principle has not before been observed.

Defective check.

106. That the want of a proper check, and the consequent neglect

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\* Vide para 92. The trifling difference (of 63 tolas) would have been more than made up if all the minor items of loss had been investigated.



of investigation, have been the true cause why the truth has not earlier been discovered, seems to be confirmed by the fact of the prevailing unconsciousness that there is any thing to be amended. In the latest accounts the “waste” is entered as a matter of course, and as if it really were “unavoidable,” and no apology or explanation, that I am aware of, is offered for the large deficiencies which are still recorded. Hence, when such large sums as those mentioned in para 92 can be lost sight of, without the officers of Government being aware of the fact, it seems to be unnecessary to seek for any other evidence to prove that the system of check cannot possess all the efficiency necessary for the security of the property of the State.

107. Perhaps the explanations which accompany this, of the intimate causes of error and deficiency hitherto prevailing in all our management, may go far towards the prevention of the like errors for some time to come; but I fear, if a sound system be not established, the advantage to be derived from past experience will run great risk of being soon lost; and while I am assured that nothing but a strict system, and the closest attention, will permanently exempt a Mint from those losses which arise from the dishonesty of its inferior agents, I am apprehensive lest difficulties from this cause, and the confusion which often attaches to Mint subjects, may hereafter possibly obscure the truth which I have been at much pains to establish.

108. Should it happen that, contrary to my humble anticipation, I have failed to convince those higher authorities into whose hands this report may be placed, of the accuracy and truth of the important principles which I have laboured to enforce and demonstrate, and should the conclusions which I have above ventured to record still be denied or objected to by Officers whose experience and ability entitle their opinions to respect, I feel that I owe it, not less to my own character, than the interests of the Public service, to solicit that the whole subject may, with as little delay as possible, be referred for the opinion of some unbiassed authority in Europe, whose scientific eminence and knowledge of the subject may be such as to put his decision beyond dispute.

FORT ST. GEORGE, MINT, }  
15th March, 1855. }

J. T. SMITH,  
Mint Master.

## MEMORANDUM A.

### UNREPORTED FRACTIONS.

1. It is of importance that we should have a distinct idea of the nature and value of unreported fractions, and it is not very easily attained. The following observations are therefore given:—Unreported fractions are not like the shillings and pence of a large sum, which constitute a trifle distinct from the pounds; but they are fractions representing a certain proportion of the whole sum. For instance, A and B are joint owners of a large sum, of which A is to have 90, and B 10 per cent; the unreported fractions are similar to what the case would be, if A's share were 90, besides  $\frac{1}{4}$ th unreported, and B's 10 minus that quarter; and this quarter, it must be noticed, is  $\frac{1}{4}$ th per cent of the *whole* sum, whatever it be.

2. As it will appear presently, that the average value of these fractions is about  $\frac{1}{8360}$ th of the whole value operated upon, it will be easily perceived that, when 3 or 4 crores of bullion are received by the Indian Mints annually, the value of the unreported fractions is not unimportant—with the larger sum they would come to 45,000 Rupees.

3. As shown by the illustration above given, the fraction unreported indicates, not only an excess of the silver in the compound, beyond the report, but also a defect of copper, less than the report. The oversight of this fact led Mr. Curnin into the great error of calculating the benefit by the unreported fractions at only  $17\frac{1}{2}$  grains per 1,000\* tolas. He looked only at the excess of silver represented by the fractions, and forgot that that very excess occupied the place of copper; so that the chief gain by the fraction was, not by putting in copper as alloy to this excess of silver, but copper to fill up the place occupied by it, in a compound rigidly calculated.

4. Using the former illustration, an "alligation" is a mixture or compound mass in which A ought, according to the Indian standard, to possess 220 parts, and B 20; or as 11 to 1; but when made arithmetically, with silver reported by the "trade assay," the mass contains, not only 220 parts (out of 240) of A, but  $220\frac{1}{4}$  parts of A, and only  $19\frac{3}{4}$  parts of B. There

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\* Correspondence relative to Indian Mints, page 76, paras 39 and 40.

is therefore required, to make the mixture rigidly correct, (allowing for the fractions)  $\frac{1}{4}$ th part more of B, to make up for its deficiency, and in addition  $\frac{1}{11}$ th of  $\frac{1}{4}$ th part of B, as alloy to the surplus quarter of A.

5. I have shown, elsewhere,\* that the average value of all the fractions is  $\frac{1}{4}$  dwt. if no allowance be made for cases wherein the title falls upon the precise dwt. or  $\frac{1}{2}$  dwt; Mr. Curnin also estimates the average at 6 grains in the lb. or  $\frac{1}{4}$ th dwt. That is,  $\frac{1}{4}$ th of the  $\frac{1}{240}$ th or the  $\frac{1}{960}$ th part, represents the excess of silver and deficiency of copper beyond the Assay Report.

Hence, the extra quantity of copper to be put in, to make up for this, is  $\frac{1}{960}$ th to make up for the deficiency of copper, and  $\frac{1}{11}$ th of  $\frac{1}{960}$ th or  $\frac{1}{10560}$ th as alloy to the excess of silver; and the total gain in standard silver, resulting from the fractions is  $\frac{1}{960}$ th plus  $\frac{1}{10560}$ th, or  $\frac{1}{880}$ th, which is equivalent to Rupees 1-2-2 per 1,000 tolas, or Rupees  $113\frac{1}{2}$  per lac.

6. According to the experience of the officers of the Royal Mint, a deduction of  $\frac{1}{3}$ th† ought to be made from this, to represent the cases in which the assay happens to fall on the precise dwt. or  $\frac{1}{2}$  dwt.; and this would reduce the gain to somewhat less than 91 tolas per lac; but it will be seen that the experience of the Bombay Mint differs from this; the actual gain by unreported fractions during twelve years having been Rupees 184,595 on a coinage of 154,297, 377‡ or at the rate of 119 tolas per lac,  $5\frac{1}{2}$  tolas beyond the calculated average.

7. The experience of the Madras Mint cannot be ascertained, for the reason stated in para 21 of the report, viz., that the fractions are not made known, as in Calcutta and Bombay; but it is evident from the result of the meltings generally, that it does not differ very much from that of Bombay, the whole amount of extra copper used in all the Mints being not very different when due allowance is made for the resulting fineness of the coins;§ whence we may infer that the gain by unreported fractions in Madras is probably not much below the calculated amount.

8. In the Calcutta statements the unreported fractions vary so much in amount, and are so irregular during the years they have been entered, besides being far beyond the calculation, that there appears to be some mistake in re-

\* Observations on Indian Mints, page 174, para 61.

† Vide Mr. Beckwith's evidence before the select Committee on the Royal Mint, in 1837, Art 788.

‡ Vide statement, Appendix No. 6.

§ Vide Memorandum B, para 18.

cordova them. Probably they have been joined with the gain by melting late standard Rupees.

9. If I have succeeded in explaining the subject as I ought, it will be understood that "unreported fractions" are a source of gain to the Mint, to the full extent of their value, provided the coins are issued of

Unreported fractions cause gain to their full extent. *exact* standard fineness, for there is no fractional gain or loss in the valuation of *them*.

But as their value depends upon certain casual circumstances, connected with the assay, they cannot be rigidly calculated before hand, but may be assumed to vary from 90 to 120 tolas per lac of the bullion; and, according to the experience of the Bombay Mint, have actually realised about 119 tolas per lac.

10. If there be no loss of silver, it is evident that the unreported fractions ought to cause an excess in the out-turn, beyond the register,

There ought to be a surplus delivery on account of them.

of from 90 to 119 tolas per lac of the bullion worked, as above, because copper may be added to bring them and the rest of the bullion to "standard," and any loss of inferior metal may be anticipated and allowed for; and as the experience of the Madras Mint seems to show that the value of silver left in the drosses may be economically reduced to less than 10 tolas per lac, it will be obvious that a sufficient margin would

Amount of that surplus.

be left, if the Government were to require the unreported fractions to be delivered at the rate of only from 80 to 110 tolas per lac,\* making no allowance for silver left in the drosses.

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\* We may expect the surplus on account of unreported fractions will generally average one Rupee per thousand, or one hundred Rupees per lac; for, practically, we have no right to expect them to exceed 110, and 10 will be left in the drosses. We have seen that they sometimes do exceed that ratio, but as the calculated amount is only  $113\frac{1}{2}$ , any excess beyond that must be looked upon as accidental. In addition to this there ought to be recoveries in the pre-melting department, which will probably vary from 20 to 60 Rupees per lac, of the bullion operated on.



## B.

### ADDITIONAL ALLOY.

1. When the "alligation," or mixture of silver and copper, has been precisely made, allowing for unreported fractions, and is rigidly "standard," it is obvious that no more copper ought

Object of additional alloy. to be put into it, except to obviate losses of base metal during manipulation—to exceed this would be to spoil the accuracy of the mixture.

2. Conversely, after the alligation has been precisely made, and a further quantity of additional alloy has been put into the melting pot, if the resulting composition of the coins, on full examination, proves to be true "standard," I think we may justly conclude that an amount of base metal, equivalent to the additional alloy, has been separated during the manipulation.

How refinement of metal takes place.

3. The true use and object of additional alloy, therefore, is to meet this waste of the inferior metals, or refinement of the silver in its passage through the Mint; and, as such, it ought to be separately entered in the accounts.

Additional alloy is to cover refinement.

4. Additional alloy is the cause of an apparent, but not of any real gain to the Mint; because although it makes an addition to the weight of the standard silver, which costs nothing comparatively, yet as it is an addition exactly equivalent to a subsequent subtraction, it is evident the weight remains precisely the same as before.

Causes no real gain to the Mint.

5. In those Mints where all the bullion received is debited, uniformly, at its actual weight and assay fineness, minus the unreported fractions, the only causes which justify the addition of copper, beyond the strict alligation, based on the assay reports,

Sources of Mint gains.

are 1st, the necessary allowance for unreported fractions (of silver), to reduce them to standard, and make up for the deficit of copper they occasion; and 2ndly, the necessary compensation for refinement or separation of alloy in the course of work. Such has been the practice in Madras and Bombay. In Calcutta there is a third cause, which is explained in Memorandum C.

6. The actual separation of copper, and refinement of the metal during the operations of the coinage, is not a mere matter of conjecture. In Bombay, it is proved by the fact that the addition, which is made independently of the Mint Master, is regulated by measurement of the losses it is intended to remedy.

7. In Madras, the separation of the copper has been demonstrated, both in regard to the melting of solid bullion and scissel, and the bleaching of coins; in the latter case, the metal which has been taken out of the coins has lately been, as a matter of routine, regularly reproduced in the solid form, from the bleaching liquid, and its weight contrasted with the apparent loss by that process.

8. When, therefore, pure copper can be produced in large quantities in the metallic state, giving unquestionable evidence of the refinement of the standard metal, it cannot be otherwise than erroneous practice to neglect to compensate for its removal. Hence, the refinement of the metal caused by each of the coinage processes ought to be a matter of study by the Mint Master (who on this account, as well as many others, ought to be provided with an assayer), and the aggregate sum of all the refinements proved to take place ought to be compensated by copper put into the alligation for that specific purpose, under the head of "additional alloy."

9. The additional alloy used in the Calcutta Mint to compensate the loss of base metal was, during the First period, at the rate of  $121\frac{1}{2}$  tolas per lac.\* During the Second period, the necessity for it seems to have been lost sight of. It was greatly reduced in 1849 and 50, and abandoned in 1852. Taking an average of the whole Second period, the total amount of extra copper, under both heads (of "unreported fractions," and "additional alloy,") was  $197\frac{1}{2}$  tolas per lac. Deducting the fractions at 119, the remainder  $78\frac{1}{2}$  shows the *average* amount of additional alloy during the second period.

10. During the first period the coins issued by the Calcutta Mint were about  $\frac{1}{10}$ th dwt. or 41 Rupees per lac† above standard, showing that, if the bullion were scrupulously valued at the "trade assay," the

\* Vide Report, para 28.

† The excess of fineness, is Rupees 54,244 in 131,990,228, or very nearly 1320 lacs. Vide Appendix No. 16.

allowance of  $121\frac{1}{2}$  Rupees per lac of additional alloy was less than what was required. During the Second period, the coins appear from the only Pix Assay reports which have reached this Mint, to have been as follows.\* For the first two years, 1848 and 49, they were much below standard; in 1850, when the additional alloy was greatly reduced, they are reported 0·00073 or 80 Rupees per lac above standard; and in 1851 and 52, when it was totally abandoned, they are reported 151 and 218 Rupees per lac above it, on the great bulk of the coins. Upon the whole, the mass of the currency of the Second period is upon an average  $92\frac{1}{2}$  tolas per lac above standard. These facts show very decidedly the influence of and necessity for “additional alloy.”

Additional alloy used in Bombay Mint.

11. In Bombay, during the First period additional alloy was used at the rate of  $120\frac{3}{4}$  per lac, and during the Second period at the rate of  $124\frac{1}{2}$ .†

12. The coins from the Bombay Mint, during the First period, appear to have been above standard to the extent of about  $106\frac{1}{2}$  tolas per lac‡ proving, as in the Calcutta experience, that (unless the unreported fractions be supposed to be more than the rate assigned) the allowance for additional copper at the rate of  $120\frac{3}{4}$  tolas per lac, was less than sufficient.

13. During the Second period, the coins appear to be, on the whole, close to “standard,” a shade below, but the number of assays is too§ small (being at the rate of only one for 226,670 pieces) to permit of a correct measurement of the rate.

14. In Madras, during the the First period, there is some uncertainty as to the proportion of additional copper which ought to be considered as compensating the refinement,|| irrespective of which it appears to be 160 tolas per lac. During the Second period it is shown to have been 131 tolas.¶

\* Vide Appendix No. 16.

† Vide Statement 6.

‡ The excess of fineness on the coins for which we have pix reports is 55,182 Rupees on 517 lacs. The pix reports are one for every 185,444 pieces. Vide Appendix No. 17.

§ If the London pix assays be considered as a fair representation of the produce of the Mint, the practice would appear to have been rather irregular; the coins being very much below standard the first two years; rather below the third; rather more above the fourth, and considerably above the fifth. One year in this period is not reported. Vide Appendix No. 17.

|| Vide Report, para 28.

¶ Vide Memorandum F, para 30.

15. The Madras coins were nine tolas per lac above standard during the first period,\* and it may be supposed that the excess in the additional alloy, beyond the average, compensated for an undue quantity of “unreported fractions,” which seem to have been more particularly abundant during the first year, 1841-42, when the bullion operated on

Effect upon the coins, was that which had accumulated from the purchases in the bullion depôt. During the second period the coins were eight tolas per lac below standard; which shows that the additional copper used was rather too much, and ought to have amounted to 123 tolas per lac.

16. It appears from the experience of all the three Mints, as above stated, that the proportion of additional alloy actually used to meet refinement of the metal during manipulation was as follows:—

Calcutta, 1st period.....	121½
Do. 2d do. ....	78½
Bombay, 1st do. ....	120¾
Do. 2d do. ....	124½
Madras, 1st do. ....	160
Do. 2d do. ....	131

Average 122¾

Making allowance for the second and fifth of the above entries, the average would appear to be very nearly 124 tolas per lac, which would indicate the proper quantity of additional alloy, according to the ordinary practice of the three Mints, hitherto, *if the coins had agreed with “standard.”*

17. It must be remembered, however, as stated in Memorandum F, para 40, that the loss of base metal, or refinement, probably depends very considerably on the care exercised in pre-melting; besides which, the total amount of copper added to make up the standard, will also be influenced by any irregularity in the assays, tending to increase or diminish the amount of the “unreported fractions.”

18. To some of these causes we must attribute the irregularities of the accompanying table, showing the additional copper which *was* added, and *ought to have been* added, or as it might be termed, the “saturating complement” of copper in the three Mints during both periods.

\* Vide Appendix No. 14.



TABLE showing the "Saturating complement" of Copper in the three Mints, during both periods.

	Unreported Fractions.	Additional Alloy.	Undue refinement of Coins.	Total.
Calcutta 1st period*	119	121 $\frac{1}{2}$	41	281 $\frac{1}{2}$
Do. 2nd do. *	155 $\frac{1}{4}$ §	42 $\frac{1}{4}$	92	289 $\frac{1}{2}$
Bombay 1st do. †	110 $\frac{1}{4}$	120 $\frac{3}{4}$	106 $\frac{1}{2}$	337 $\frac{1}{2}$
Do. 2nd do. †	127 $\frac{1}{2}$	124 $\frac{1}{2}$	7 $\frac{1}{2}$	259 $\frac{1}{2}$
Madras 1st do. ‡	119	160	9	288
Do. 2nd do. ‡	119	131	8	242

The average of the sums in the last column, (283 very nearly) shows the total amount of extra copper required in the three Mints to bring the coins to exact "standard." Deducting unreported fractions, it gives 164 for additional alloy.

19. In the Calcutta and Bombay Mints much of the irregularity is perhaps due to the very imperfect measurement of the fineness of the coins issued, the pix assays upon which it is founded in each case being far too few in number, and also adjusted to a different standard from that by which the coins were adjusted ; but this explanation does not hold good in reference to Madras, where the measurements are founded upon a sufficiently wide basis.

20. Were the practice of all the Mints reduced to as much regularity and uniformity as we may reasonably think practicable, the results shown by such a table as the above, would doubtless be uniform too ; but hitherto there have been too many causes of variation to admit of close agreement, even in comparing long periods of experience, much less single years. In future, as most, if not all these causes have been pointed out, and remedies suggested, it is to be hoped that more uniformity will be attainable ; and I may add, in concluding the subject of additional alloy, that when the table shows a material difference between the amounts of the "saturating complement" of copper for any two periods, it ought to be explained by a corresponding difference in the total amount of gross, or apparent, loss in manipulation ; otherwise, if the manipulation has been unchanged throughout, and the apparent loss is the same as usual, the difference must be attributed to a difference in the assays.

\* Vide Statement No. 3, and Report, paras 22, 23, 28 and 32.

† Vide Statement No. 6,                   ‡ Vide Statement No. 9, and Report, paras 28 and 37.

§ The figures here entered are in agreement with the public accounts ; I have elsewhere taken the unreported fractions at 119, and considered the rest of the extra copper as additional alloy.

|| Minus.

## C.

## LATE STANDARD RUPEES.

1. In consequence of the error in the trial plate, which was discovered in 1825, all the coins issued by the Indian Mints previous to that date were too fine, by from one to two dwt.; that is, contained more than the proper quantity of silver, in the proportion of from 400 to 900 Rupees value in every lac.

Cause of gain by "late Standard Rupees" explained.

2. The currencies to which this refers have now become obsolete, and the pieces are from time to time brought to the various Mints for recoinage; and it is the custom in Madras, as well as Bombay, apparently, to treat them in the accounts of the Mint exactly in the same way as all other bullion; debiting them at their true assay, minus the unreported fractions.

Does not occur in Bombay and Madras.

3. But in Calcutta, the practice seems to have been different, and the late standard Rupees are received as "standard" and entered in the Mint accounts at that fineness; credit being afterwards given for the gain arising from their superior quality, by a separate entry.

Occurs in Calcutta, owing to difference of practice.

4. Perhaps it would be advisable, for the sake of simplicity and perspicuity in the accounts, if the practice of Madras and Bombay were adhered to, and all bullion treated alike; because then the effect of manipulation would be known before-hand, which would afford a valuable check; but the result is the same, when the gain is separately recorded.

Practice should be altered.

5. What we have particularly to notice in this place is, that the gain arising from the Calcutta system is exactly similar in character to that arising from unreported fractions; the only difference is, that it is not *fractions* of a dwt. that are unreported, but the penny-weights themselves; and the gain arising therefrom is not limited to 100, or 120 tolas upon every lac of Rupees value received, but is found in practice to yield from four hundred to nine hundred, as above stated, and on the average about five hundred. As this is an excess of *silver* beyond the account, it ought (as I have stated in regard to the unreported fractions) to be delivered as a final surplus at the close of the manipulation; and that, in addition to the gain by unreported fractions on the other bullion.

Gain similar to that of "unreported fractions."

## D.

## LAMINATING.

1. Until the present system of check was established in this department, the cause of irregularity in the daily balances was not known; and although they were closely watched from the time that the general results fell off in 1848, yet the reason of the decline continued doubtful.

Cause of deficiency in lamination unknown.

2. It is true, that by Mr. Prinsep's experiments in 1836, the addition of oxygen to the straps, in a triple annealing, had been shown to be the cause of an increase of weight of 14 tolas per lac of the bullion worked (which would be about 24 tolas per lac of out-turn of the Mint); but in applying this experiment to our work, it was doubtful whether

Surplus indicated by theory and experiment,

a very large deduction from this rate might not be necessary, when there were only two, instead of three, annealings; besides which, it was justly argued by the Superintendent of the room that, although in a carefully conducted experiment, with rolls in a well polished state, the above-mentioned surplus might easily be obtained; yet as, according to Mr. Prinsep's theory, the oxygen necessary to form peroxide of copper united with four parts by weight of the metal, and as it is pretty certain that part of the oxide of copper must be rubbed off in the course of lamination, it would follow that if only one-fifth of it were removed, the whole of the excess created by oxidation would be neutralized; and that nothing could be more

Doubts as to application of the above.

likely than this in the ordinary course of work, especially in Madras, where from our scanty supply of machinery, we were often obliged to use the rolls in a rough condition; so that the fact of our occasional deficiency was readily explained.

3. To this was added the argument that, whatever the result might be when the metal was only laminated sufficiently to be cut into

Further doubts.

Rupees, it is obvious that there is a much greater probability of the separation of the oxide of copper, and loss thereby, when the straps are so much further attenuated as to fit them to be cut into  $\frac{1}{8}$ th Rupees, and  $\frac{1}{4}$ th Rupees, of which our coinage contained a much larger proportion than the other Mints.

4. These arguments had their weight, and more particularly in regard to the small coins, which I long thought it possible might be the

Further doubts.

occasion of a loss; but the fact which first, and more strongly, attracted my attention was the *irregularity* in the daily results. I argued that, if the processes through which the bullion passed were, as they were known to be,



uniform, the results ought to be so too; or we ought to discover the reason of variation; otherwise, the only cause which could explain the irregularity was speculation.

5. The discovery of silver in possession of some of the servants, as stated in the report, proved that this view was correct; but still it seemed as if speculation were impossible. At the time that it was thus proved

Discovery of theft. to be going on, every door and window, except two required for use, had been nailed or

screwed up; and these two put under lock and key, which never left the possession of the Superintendent or his Deputy, in whose presence every workman who left the room was most strictly searched (naked). The failure of these precautions proved that the thefts must have been committed by swallowing the pieces; and it may be proper to mention, in

How practised. reference to this supposition, that on one occasion a man was observed putting pieces

into his mouth; and information being given, he was removed to a hospital close at hand, and caused to disgorge the contents of his stomach, when 11 Rupee blanks were brought forth (of the old coinage). This did not happen within my own knowledge, but was told me by an eye witness, the Surgeon of the hospital.

6. Experiments which had been made in the melting department, to trace the causes of apparent loss in melting the scissel, had shown the probability that a large portion of it arose from dirt\* brought from the

Causes of surplus in lami- laminating room; and subsequently, the fol-  
lating department. lowing direct experiment, which has been

frequently made upon various kinds of scissel, not only proved the fact, but also furnished a measure of the amount of adherent matter.

7. On several successive days, a thousand tolas at a time, of Rupee scissel, taken in the ordinary state in which it had been actually handed over to the melter, was weighed very carefully in a large assay balance, capable of showing the difference of a grain, then boiled in dilute sul-

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\* In using this expression, I do not by any means intend to convey the idea that the laminated straps are more covered with dirt in Madras than elsewhere. On the contrary, the utmost precautions being taken to avoid the contact of oil, and all the operations of the department being conducted in a most orderly and cleanly manner, the scissel and blanks are as clean as they could be; and when the rollers are newly polished they are as bright as their surfaces; and at all times are free from anything which could soil the finger, or be capable of separation, except by the acid. Nevertheless they are discoloured by the oxidation of the copper, and thereby increased in weight; and it is the necessary removal of this oxygen, with the copper, which causes the apparent waste in bleaching; part of which is caused by additions made to the surface of the straps in the laminating room.



phuric acid, *thoroughly* dried, and re-weighed, and the loss noted. I may here mention, that the sulphuric acid bath, at the close of the experiments, was always found to contain an insoluble powder, which was chiefly composed of carbon, with silica—a sooty deposit.

Experimental measurement of surplus.

8. At the end of a certain number, usually ten, of the above experiments, the average loss was calculated ; and the bleaching liquid, which had been carefully preserved, was, after filtration, deprived of its copper, by the addition of a little hydrochloric acid, and repeated boiling with clean iron rods.\* When proved to be perfectly free, the copper was collected and weighed and afterwards fused with black flux ; and the weight of the metallic copper was deducted from the total average loss previously ascertained ; in order to show the loss of oxygen and dirt. The result obtained in this way, with scissel, generally indicated a surplus a trifle greater than the excess of weight realized in the laminating department ; and on the other hand, the results afforded by precisely the same operations carried on with all the blanks, (the copper being as a matter of routine carefully separated from all the bleaching liquid) fell below it, showing, as might have been anticipated, that the blanks part with a portion of their attached oxide and dirt, by handling.

Details of the experiments.

Nature of the results obtained.

9. From these experiments it appeared that, with  $\frac{5}{8}$ th inch ingots only twice annealed, the excess of weight in the blanks, caused by oxygen and soot, when measured on four separate occasions, by trials of 10 weights each, amounted to the ratio of  $23\frac{1}{2}$ , 20, 21, and 20, average 21 tolas per lac. The actual results of the work of the bleaching department, when examined in precisely the same manner, except that the weighments were made by the ordinary balances, (the acid bath is in a leaden vessel, and the utensils employed in the operation are all of silver,) gave for six months, the following results :—First 20, second 13, third  $21\frac{3}{4}$ , fourth 23, fifth 22, sixth  $20\frac{3}{4}$ . Average 20 tolas per lac.†

Statment of the results of measurements.

10. Observing that the results during the second month vary so

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\* The boiling is always done a second, a third, and sometimes even a fourth time. On the last boiling the deposit is a black powder, which has somewhat the appearance of plumbago, and is composed almost entirely of iron, with hardly a trace of copper ; but even this is not allowed to escape, but is melted with black flux, and any particles of copper which may be gained thereby are added to the previous recoveries.

† Vide Memorandum F, note to para 32.

much from the mean, and that, without it, the average of the remaining five is  $21\frac{1}{2}$  tolas, and looking to the results of the single experiments, I think we cannot be far wrong in stating that, with  $\frac{5}{8}$ th ingots, twice annealed, the Rupee blanks are delivered with an excess of weight amounting to about 21 tolas per lac.

Average surplus with  $\frac{5}{8}$ th inch ingots.

11 The scissel has only been tried on three occasions, by cutting up a thousand tolas at a time, and uniting ten weights together in the recovery of the copper from the bleaching fluid; the results were—first series 30, second  $30\frac{5}{4}$ , third, with five weights of 1,000 tolas each,  $30\frac{1}{2}$  tolas. Average  $30\frac{1}{2}$  tolas per lac of scissel operated on.

Average surplus with Rupee scissel, from  $\frac{5}{8}$ th inch ingots.

12. To calculate the influence of these data on the general out-turn of the laminating department, we must assume that the blanks and scissel are to one another in the ratio of five to seven; which is about correct in regard to the largest amount of work. Then  $7 \times 21^*$  tolas, plus  $5 \times 30\frac{1}{2}^\dagger$  divided by 12 gives very nearly 25 tolas per lac, as the rate of increase upon the whole bullion operated on; which corresponds with  $42\frac{3}{4}$  on the blanks issued, and probably about 43 tolas per lac of the coins issued by the Mint.

Average general result in proportion to coins issued.

13. If we examine the Statement No. 10, especially the year 1852-53, when the excess in the laminating department was 37 tolas per lac of the coins issued by the Mint, I think we shall find in it sufficient evidence for the belief, that this calculation may not be far from the truth; more especially when it is recollected, that the produce of the laminating department has never yet been placed under the strict checks now in force, whilst the  $\frac{5}{8}$ th ingots have been in work. We shall

Comparison with actual practical results,  $\frac{5}{8}$ th inch ingots.

presently $^\ddagger$  see that, since the depredation of silver has been rendered impossible, by the use of the counting machinery, the actual surplus realized has rather exceeded than fallen short of the rate indicated by similar experiments; and I am therefore inclined to anticipate that, when the same strictness of check is brought to bear upon the work of the  $\frac{5}{8}$ th inch ingots, the surplus will be fully 40 tolas per lac of the Mint issues, if not more. Without the checks, the rate has never been less than 30 tolas, since 1852-53.

14. We have not had an opportunity of testing the effects of the triple annealing on the straps from ingots one inch thick, to so great an

\* Vide para 10.

† Vide para 11.

‡ Vide para 22.

Experiments with 1 inch ingots. extent as I could wish, as we have only had these ingots in use for a few months ; and during these, the work of the small coins has been so much mixed up with that of the Rupee pieces, that it has not been possible to obtain more than three months experience fit for use. Of these, the first gives the increase on the blanks of 20 tolas per lac, the second 28, the third 21 ; average of the three 23 tolas per lac.

Average result of Rupee blanks, from 1 inch ingots.

15. With respect to the scissel, experiments have been made on three occasions, as before, with ten weights of Do. of Rupee scissel, from 1 inch ingots. 1, 000 tolas each, and the results were as follows : First experiment  $32\frac{1}{2}$ , second  $37\frac{1}{2}$ , third 42, average 37.

16. Combining these rates, in the same manner as before, in order to show what the increase of weight would probably have been upon the whole of the bullion passed through the laminating department, the result arrived at is nearly 29 of the bullion worked, or  $49\frac{3}{4}$  Rupees per lac of the blanks delivered, and a trifle more than that rate compared with the coins issued by the Mint. It must be remembered that this applies to Rupee pieces alone.

Surplus to coins issued, from 1 inch ingots.

17. From a comparison of these results with those above stated, as attending the use of  $\frac{5}{8}$ th inch ingots, it will be observed that the difference is not very great, though it is sufficiently marked to be observable, and that it gives the greater increase to the produce of the thicker ingots, the metal having undergone a third annealing.

Results from  $\frac{5}{8}$ th inch, and 1 inch ingots, not very different. That the difference is not more, arises no doubt, from the fact that the oxidation depends upon the amount of superficial area exposed in a heated state to the air ; and this area is the same per lac of tolas weight, in both cases of thick and thin ingots.

18. The effect is very different when we inquire into the comparative influence of annealing on the metal manufactured into the smaller coins, where a larger superficial area per lac of tolas' weight is exposed to the flame. The inquiry is in some measure interesting, but not of so great importance as that respecting the Rupee pieces, as the smaller coins usually form but a small proportion, in value, of the whole work. It is therefore of the less consequence that I have to quote from but a few experiments, in stating that the excess of weight upon quarter Rupee scissel and blanks from  $\frac{5}{8}$ th inch ingots (we have no experiments on the

Surplus greater with small coins.



smaller coins from 1 inch ingots) has been found to be at the rate of 59 tolas per lac of the former, and 30 of the latter ; which rates when combined, as before, would indicate an increase of 42 tolas on all the bullion worked, corresponding with 72 per lac of the weight of coins delivered by the Mint.

Surplus with  $\frac{1}{4}$  Rupees.

19. In a similar manner, the scissel and blanks of two anna pieces from  $\frac{5}{8}$ th inch ingots, have been found to yield an excess, the former of 71 tolas, the latter of 47 per lac of their weight ; which rates combined give the rate of general increase on all the bullion worked of 57 per lac, corresponding with about 98 tolas per lac of the coins issued by the Mint.

Surplus with  $\frac{1}{8}$ th Rupees.

20. From the limited number of experiments made with Rupee blanks and scissel produced from the thick ingots, I think it not impossible that the results arrived at may require some little correction ; at present it would appear that the excess shown by them is rather below, than beyond the truth.

Above results may require correction.

21. The actual excess in the laminating department during the eight months that 1 inch ingots were worked, somewhat exceeds the rate deduced from the above experiments ; although the surplus is arrived at, as regards the blanks, by deducting the weight of metallic copper actually separated from them, from the total apparent waste in milling, cleaning, and stamping (after recovering silver particles detached in these operations.) That is to say, the total difference in weight between the blanks, as received from the laminating, cutting, and adjusting departments, and the finished coins sent to the General Treasury, would appear to be, if any thing, *less* than the share in the surplus deliveries by the laminating department which is properly due to the milling and bleaching room.

Actual surplus with 1 inch ingots.

22. For instance, the actual surplus delivery by the laminating department upon the coinage of 21 lacs tolas' weight of coins from thick ingots was 1,400 tolas, or at the rate of 66 tolas per lac ; and as it appears by the results recorded in paras 14 and 15, that the respective surplus weights on the scissel and coins are, with thick ingots, to one another in the proportion of 161\* for the coins, to 185† for the scissel, it follows that the coins must have carried with them, according to the experiments quoted,  $\frac{1}{3}\frac{6}{4}\frac{1}{6}$ ths of the whole dirt and oxygen (1400) or 651 tolas ; whereas

Particulars stated.

\* 7 × 23, vide para 14.

† 5 × 37, vide para 15.



the net apparent waste, after deducting the copper recovered, was only 505; for the total apparent waste, in all the operations of milling, bleaching, and stamping, amounted to 2,037 tolas, and the solid copper recovered was 1,532 tolas:

23. The reason of the excess of the rate (66) of surplus just noted above, beyond that deduced from the experiments with inch ingots before given ( $49\frac{1}{2}$  tolas)\* is the additional surplus caused by the fabrication of small coins. As stated in para 18, we have not yet made any accurate experiments upon the small coins from the thick ingots; those from the thinner ones, however, are sufficient to show that the excess in working the fractional silver coins ought to be much more than that attending the fabrication of whole Rupees, a fact which is confirmed by the difference in question.

24. The actual number of the larger and smaller pieces cut during the eight months whose experience is stated in para 22 was as follows:

	<i>Tale Lacs.</i>	<i>Value Lacs.</i>
Whole Rupees.....	18.77	18.77.
Quarter do.....	5.51	1.38.
One-eighth do.....	10.30	1.29.
	—	—
	34.58	21.44.

This shows a larger proportion of the smaller coins than forms the work of other Indian Mints, so that we ought not to expect so large a surplus in the out-turn of the laminating room in general, as that stated in para 22, viz., 66 tolas per lac; but, adverting to the results of the experiments with the large and small coins separately, we may perhaps not be far wrong in expecting it to vary from 50 to 60 tolas, according as the small coins may have been more or less numerous.

25. By examining the detailed statement of daily work, which is given in connection with Memorandum E,† it will be observed, that the only operations which cause apparent increase in weight are the three annealings, and that their influence is about in proportion to the length in feet of the straps, at the time they are in the oven, or in other words, to the superficial area exposed. The first heating appears to have given an increase of 35 tolas, or about  $5\frac{1}{2}$  tolas per lac of the bullion worked,‡ the second 66 tolas, or about  $10\frac{3}{4}$  per lac, and the third 110 tolas,

\* Para 16,

† Appendix No. 21.

‡ 6,15,686 tolas.

or nearly 18 per lac. Total 211 tolas or  $34\frac{1}{4}$  per lac of the weight of bullion worked. The bullion is subject to various apparent losses in the course of rough lamination, finishing, and cutting, which in the aggregate are recorded as amounting to 69 tolas, or  $11\frac{1}{4}$  per lac of the bullion worked ;

but as these apparent losses consist, for the most part, of standard silver, and only in a small proportion of the oxide of copper and soot which caused the increase, it is found that four-fifths of the weight of them is recovered from the sweepings of the room ; so that the actual deduction from the increase of  $34\frac{1}{4}$  tolas as above stated was, in the month detailed in the statement, only about  $2\frac{1}{4}$  tolas, and the final net increase about 32 tolas per lac of the bullion worked, which corresponds with about 55 tolas per lac of coins\* issued by Mint.

26. It is proper here to mention, that the results fluctuate a little owing to various causes ; but as far as a judgment can be formed after only a short period of the close observation required for such analysis, I am of opinion that those which are above given will be found not very far from correct, as indications of the effects of the various processes carefully carried out.†

The fuel used by us is charcoal and firewood, in the proportion by weight of about seven of the former to one of the latter ; at the first two annealings the straps are quenched in cold water, and occasionally after the third also, and we have found but little difference in the result whether this be done or omitted. The effect of using charcoal alone has also been tried, but this did not appear very materially to influence the results. I am inclined to

believe that, probably, the method of packing the ingots and straps together, when they are placed on the carriage by which they are rolled into the furnace, may have a greater influence, but this has never been made the subject of experiment.

27. Having now, as I trust, shown sufficient grounds for my assertion of an excess in annealing, which, pending more accurate experiments

\* Rupee pieces.

† It is quite possible that, owing to the particular attention paid, the annealing may have been more perfect than it would ordinarily be in other Mints, and hence that the excess realized may have been greater. I have not been able to find any evidence of this by inquiry in the department, but I infer that it may have been so from the fact of the bleaching loss having been increased considerably. It will be evident, however, from a perusal of what is stated in para 2 and elsewhere, that a greater surplus in the laminating department, is by no means, any assistance practically in closing the accounts, since every tola gained in weight by the adhesion of sooty particles leads to a corresponding loss in bleaching and melting ; and for every tola gained by the union of oxygen with the metal, a loss of 5 tolas is experienced.

with the larger ingots, may be approximately fixed for them at from 50 to 60 tolas per lac of the coins issued, I must add that the only experiments which I have met with giving an opposite conclusion, are some un-

dertaken by the officers of the Bombay Mint in January 1834, and which, in general, record

a loss—but the reason of this is quite apparent, when the record is examined\* with reference to the true cause of excess; for it will then be perceived that, in every instance, the ingots were either weighed *after* annealing, so that its influence was not observed, or the effects of it were done away with by the straps being cleaned with a cloth afterwards, and before weighment.

28. Mr. Prinsep's experiments, in 1836, agree in the fact of an excess, but record a much smaller one than that stated above; his result being only  $2\frac{1}{4}$  annas per mille, or 14 tolas per lac, corresponding with 24 tolas per lac of the coins issued, in lieu of 50 or 60. This can only be

accounted for, if the ingots had been *three* times annealed, by their having been cleaned from any deposit, as in Bombay, previous to lamination; otherwise, the experiment should be repeated on a larger scale, when I think it could not fail to be attended with results more or less the same as those which have been detailed above.

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## E.

### CHECKS IN THE LAMINATING DEPARTMENT.

1. The system of check at present, (May to December 1854), followed in the laminating, cutting, and adjusting departments, has been recently adopted; chiefly with a view to the acquisition of distinct and

certain data as to the proper results of the ordinary business, and also to check the daily petty pilferings, which it was at last proved were going on. It consists of two chief precautions, first, the mechanical registry of all the pieces as they are cut, effected by counters attached to the cutting presses, the registers being compared with the delivery by the cutters, and second, of an exact weighment of the bullion before and after each annealing, as well as before and after cutting.

2. The frequent weighments would have caused some inconvenience and expense, during full work, had it not occurred to me that, as we only require accuracy to the thirty or fifty thousandth part; it would be

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\* Vide Appendix No. 22.



practicable to make a balance sufficiently accurate, capable of taking larger weights than the usual ones of 2,000

How the difficulty of numerous weightments was overcome. tolas, (about 63lbs.), and therefore, borrowing a hint from one which had been made for the General Treasury,\* and found very convenient there, a large balance was constructed, capable of weighing five times the usual drafts; and by the use of it, all difficulty on that head has been done away with.

3. A daily report is made to the office, showing the changes in weight caused by each particular process, upon all the bullion subjected to it, and these particulars are recorded in a table, of which a specimen, showing a month's work is hereto appended.†

4. From the information therein given, it is easy to detect the variation of a single tola from the ordinary result, when the delivery is of thirty thousand Rupees daily, and there can be no doubt that the scrutiny would be proportionably close with larger out-turn. The chief security, however, seems to be in counting the pieces at the moment

Pieces unchemically counted and registered.

they are cut; because they are the only piece of metal which could be swallowed with impunity, and all other modes of theft are guarded against.

5. I have, in para 25 of Memorandum D, given the detailed particulars of the increase of weight occasioned by the different annealings, taken from the facts recorded in Appendix No. 21. From the same

source, the following details of the apparent losses in laminating, cutting and adjusting departments are taken. First, the apparent loss,

Losses in laminating, cutting and adjusting.

(amounting to 34 tolas), by rough laminating the ingots, comes to rather more than  $5\frac{1}{2}$  tolas per lac of the bullion operated in the department;‡ the weight of which was 6,15,686 tolas, the apparent losses in finishing  $9\frac{1}{4}$  tolas, and (disk) cutting ( $14\frac{1}{2}$ ), taken together, came to nearly 4 tolas per lac; and the losses in sorting, and second (or blank), cutting (11), to about  $1\frac{3}{4}$  tolas per lac more; so that, in all the operations from the first receipt of the clean ingots, to the delivery of the cut and adjusted blank (there is no filing), the total apparent losses (69), are comprehended by a rate of  $11\frac{1}{4}$  tolas per lac of the bullion worked; or 19 tolas per lac of the

\* A description of this balance will be found in the 4th volume of the Professional Papers of the Madras Engineers.

† Vide Appendix No. 21.

‡ The bullion worked is calculated by adding together the total weight of blanks, 3,06,356, scissel, 2,30,883. In addition to this, during the month of September 1854, bullion weighing 78,447 was wrought for experiment, not included in the above.



weight of the blanks; while the increase in weight by the three annealings (211 tolas), amounts, as shown in Memorandum D, para 25, to something more than  $34\frac{1}{4}$  tolas per lac of the bullion worked, or nearly 59 of the blanks; thus leaving a clear gain before any recovery is made from the sweepings, of 40 tolas per lac of the blanks, or rather more per lac of the Mint out-turn.

6. I use terms indicative of a positive increase, and only an apparent loss, because the former, after allowance has been made for the apparent losses, is immediately made good in the delivery; but the losses are afterwards in great measure done away with, about four-fifths of them being recovered from the sweepings; so that the ultimate real deduction on account of the apparent losses, for the month contained in Statement No. 21, was only at the rate of about  $2\frac{1}{4}$  tolas per lac of bullion worked, or four tolas per lac of the Mint out-turn; and the increase of weight by annealing in the laminating department, having before been shown to be at the rate of 59 tolas per lac of the Mint-out turn, this deduction leaves the net surplus delivery at 55 tolas per lac of the same.

7. It will be seen from what is above stated, that the recoveries from the dross, which form an essential part of the system in this department, amount on an average, with inch ingots (though our experience with them is but limited), to 15 tolas per lac of the issues by the Mint. That is when Rupee pieces are coined. With the smaller pieces, both the apparent losses and the recoveries are greater than with Rupees.

Amount of recoveries of silver in the laminating and cutting departments.

## F.

### MELTING.

1. Dr. Ure has well remarked (Dicty. Art. Lime Chloride), that "Science has done only half her duty, when she describes the best apparatus and manipulation of a process. The *maximum* produce should also be demonstrated, in order to show the manufacturer the perfection which he should strive to reach, with the *minimum* expense of time, labour, and materials."

Benefits gained by inquiry.

2. On this account, considerable pains have been taken to discover the causes of apparent loss in the various processes of coinage, and, whenever possible, to subject them to accurate measurement; and particularly in melting, it has been thought desirable to endeavour to trace and account for the apparent deficiency, as the only means of obviating actual waste.

Much pains have been taken in experiment.

3. The first and most important point to be settled in this inquiry was, whether there were any volatilisation of the silver in ordinary melting, a question which has been the subject of some difference of opinion, but which I think is satisfactorily decided in the negative, by the following experimental results. I give them in the order of their importance, rather than according to the dates of observation. First, it was stated by me on a former occasion, that an examination had been made of the

First inquiry as to volatilisation of silver.

chimnies of the furnaces in which the silver was melted, and that 70 grains of silver had been found in them. This fact of itself seemed to me sufficient to demonstrate that there was no good reason to attribute the large losses which had been experienced in melting to volatilisation of the silver; but since that time, the presence of a few grains in the horizontal flue and lower part of the chimney has been accounted for, by observing that it is possible for a minute filament or particle attached to the scissel, at the time of charging the pots, to be detached and carried by the strong draft into the lower portion of the chimney.

4. It is well known that silver *may* be volatilised, and is rather apt to be so, when very pure silver is melted “per se,” which ought never to be the case for coinage : but the volatilisation of the large quantities necessary to account for the apparent waste in melting formerly allowed, is out of the question, for it has been ascertained that none leaves the chimney, and hence, Silver well known to be volatile. if this be admitted, and the deposits (even allowing they were deposits from volatilisation), only amount in fifteen years to a few grains, it is obvious that we must adduce other causes to account for the deficiencies, which amount to thousands of Rupees annually.

5. The proof as to silver not escaping from the chimney, rests upon the evidence afforded by a careful analysis of soot taken from the interior of the upper part of the chimney of a furnace which has been in constant use for melting alligations for 25 years, and in which, during the last 13, fully six or eight crores of tolas have been melted. The soot was examined by myself, and at my request very carefully analysed by Dr. Andrew J. Scott, whose skill as an analytical chemist is well known. In order to meet any possible doubt, I give below a statement\*

\* The soot was repeatedly washed in boiling distilled water, till not the faintest opalescence was occasioned by the addition of nitrate of silver. It was then digested with pure boiling nitric acid, for a considerable time, and the solution evaporated to dryness; after which the residuum was digested with a very small quantity of boiling distilled water, which, on being filtered and tested by means of hydrochloric acid, gave not the faintest indication of the presence of silver or lead. A faint, but distinct trace of copper was shown by the use of ammonia.

of his analysis ; the result of which was, that not the slightest trace of silver or lead could be perceived, but distinct evidence of the presence of copper was obtained.

6. Secondly. The next fact which I have to adduce in support of my opinion, that the melting of standard silver is not necessarily accompanied by any material volatilisation of the precious metal, is the result of an experiment made by order of the Government of India, in the presence of the Assay Master, D. Ross, Esq., the Deputy Assay Master, W. Collum, Esq. and myself, for the purpose of investigating this very point. The experiment occupied the whole of each day, from the 24th to the 29th July, 1848, and consisted of a set of four samples of 1,000 tolas each, of very carefully prepared standard silver, which were accurately weighed in an assay balance capable of showing a difference of one grain, and then melted and cooled each six times, in separate furnaces, and the crucibles afterwards ground to powder, and, together with the drosses belonging to the furnaces, freed from the particles of silver ; which, with the melted masses to which they belonged, were compared with the original weights.

7. The result was, that in two cases the experiments failed, owing to accidents to the pots ; in one, the weight of the silver mass and particles showed an excess of five grains, which was attributed to oxidation of the copper contained in the mass of standard silver, as it had not been defended while in the furnace by a coating of charcoal, as the others were ; and in the remaining experiment the recovery of standard silver, after the separation of all extraneous matter, and hygrometric moisture from the mass, corresponded precisely with the original weight put into the crucible.

8. The two meltings had taken place in black lead crucibles, with clay tops, the whole of a preceding series of four experiments, having been abandoned when far advanced, because, as the crucibles in which they were melted had been covered with sheet iron covers, and on close examination with the microscope one of the masses exhibited a small speck, which proved to be a particle of iron, it was judged that the liability thereby shown of any one of the masses being altered in weight by the falling into it of a particle of iron, created a doubt which would vitiate the soundness of the conclusions to be arrived at by the meltings.

9. The experiment appeared to me at the time, as it does still, to



Remarks on the results obtained. show conclusively, that standard silver may be fused and kept in a fused state for hours, without the smallest appreciable loss. I have one more experiment to relate, which is as follows.

10. Thirdly. A separate melting room, quite distinct from every other apartment in the Mint, was swept out and appropriated to the object of making this trial. Having put the furnace in order, and selected a new melting pot, ten thousand tolas of silver, which had been prepared with the utmost care (it had been melted twelve times), to produce

Experimental recovery of silver after 42 times melting. uniformity, and had been pronounced uniformly standard by the Assay Master, was accurately weighed in the assay balance, and delivered over on the 13th July 1848, to a confidential person who had charge of the operation, with orders to melt and pour the silver into ingots, as many times as the pot would stand the fire; delivering the first and last ingots for assay, after every tenth melting.

11. It ought to be mentioned, that part of the silver, *viz.*, 3,000 out of the 10,000 tolas had, since being assayed as standard, been melted in one of the experiments mentioned above, and pronounced on a subsequent assay a little (about  $\frac{1}{8}$  dwt.), inferior to standard. I think it as well to mention this, but I do not think it need be considered as having any bearing upon the result; as the assay subsequent to the melting was made of a muster cut from the lump of metal cooled in the crucible, and I am aware from actual trial, that musters cut in that way may show a fineness differing from the *average* of the mass, unless precautions be taken; and even then, that it is impossible to secure accuracy to so great a degree of nicety as the  $\frac{1}{8}$  dwt.

12. At the end of forty-two meltings and pourings of the metal, the pot was found to have begun to leak, and they were therefore closed.

First result stated. After the first ten meltings, the first and last ingots upon an assay made with particular care, were reported by the Assay Master, B  $\frac{7}{16}$ ths dwt., after twenty, the average was B  $\frac{1}{2}$  dwt., after thirty meltings, the average fineness was B  $\frac{8\frac{1}{2}}{16}$ ths dwts., after forty meltings, B  $\frac{11\frac{1}{2}}{16}$ ths dwts. At the close of the forty-second melting, three assays were made, of the first, middle, and last ingots, and the report was B  $\frac{7}{8}$  dwt., B  $\frac{7}{8}$  dwt. and B  $\frac{1\frac{1}{8}}{8}$  dwt.

13. Measures were now taken to separate and collect the silver from the pot, the furnace, and the drosses of the furnace. At first (2nd August), the apparent deficiency was 488 tolas, on the third and

Result after recovery of silver from the drosses.



fourth, 340 tolas were recovered ; and at last, on the 7th September, the whole of the recoveries having been collected together and refined, the deliveries were as follows, the ingots having been *thoroughly* cleaned from dirt and oil :—

	Gross.			Standard.		
27 ingots, B $\frac{4}{16}$ dwt.....	8,640	3	0	8,673	11	8 $\frac{1}{2}$
Dross bars with muster and particles.....	1,299	1	0	1,334	15	9
Total.....	9,939	4	0	10,008	11	5 $\frac{1}{2}$

14. I am not able to account for the whole of this excess. While the experiment was in progress, assays were made with extreme care and precaution by the chloride process, the results of which, upon five musters before the meltings, gave an average fineness of 219 dwt., 22.176 grs., and a similar series of assays of three musters after the meltings, gave the fineness of 220 dwt., 17.375 grs., showing a refinement of 19.2 grains, instead of the 20 $\frac{1}{2}$  grains above calculated. This would reduce the excess by nearly 2 $\frac{1}{2}$  tolas, but the remaining difference must be attributed, either to the musters in one or both cases, not precisely representing the true average fineness of the metal,\* or to the possibility of other particles of silver than those belonging to the experiment having been mixed with them ; which there is no reason to suspect, and which, from the precaution taken, is improbable.

15. Setting aside this, as if but of secondary importance, the result of the experiment on the whole, seems to me to afford convincing evidence, that in the ordinary operations of coinage, volatilisation of the *silver* is not one of the causes of loss ; and reviewing all the evidence which has now been adduced upon the subject, I trust I may consider that point as fully established.

16. Before losing sight of this experiment, I would beg to draw attention to the remarkable fact, that the refinement during the first ten meltings was more than half what was occasioned by the whole 42. There is some irregularity in the other results, but the fact appears interesting, as showing how much greater refinement by separation of base metals, occurs in the first few meltings, than in the subsequent ones.

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\* The musters on this occasion were cut in the ordinary way, which in general represents the average fineness of the metal with tolerable exactness. I was not aware at the time, what I have since learnt, viz., the great influence which belongs to the depth of incision into an ingot or bar, and which, in extreme cases, may cause a difference of nearly a dwt. between the surface and the centre.

17. We have next to learn what the true causes of apparent waste in melting really are, and I think I shall be correct in saying, that they are composed of the five following :—

1st. Dirt attached to the coins or bullion melted in alligation.

True causes of apparent waste in melting.

2nd. Oxygen and soot attached to the scissel.

3rd. Separation of base metal, in the first melting of alligations.

4th. Ditto on the melting of scissel.

5th. Standard silver left in the drosses.

18 The first of these causes may occasion considerable loss, when the bullion is received without pre-melting, and it is difficult to distinguish it from loss arising from the volatilisation and separation of base metals, which takes place with some varieties of

Remarks on the first cause of apparent waste.

bullion (as Sycè), to a great extent. But loss by dirt is almost wholly prevented by pre-melting ;

and as that practice is either established, or about to be established in all the Indian Mints, it is only necessary here to remark, that when melted bars are received, the loss from dirt ought to be trifling. The amount of it, as occurring in the ordinary course of work in Madras, has been measured and found to be under the rate of three tolas per lac, and the loss occasioned by receiving this amount of dirt, and calculating it as silver, is covered by the practice of weighing the bars only to the one-eighth of a tola, and giving the turn of the scale in favor of the Mint.

19. Pains have been recently taken in pre-melting the bullion, to get rid, as much as possible, of any volatile base metals they may contain, in order to avoid the disturbance of the

Care taken in the pre-melting.

alligation and apparent waste occasioned by volatilisation, when melted for coinage. It is, however, impossible to effect this object fully, and the separation of base metal which takes place in the second melting must therefore be compensated by “additional\* alloy.”

Second cause of apparent waste.

20. The second item, of oxygen and soot attached to the scissel, is the cause of considerable apparent loss, depending in some

degree for its amount on the number of annealings the straps have been exposed to.

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\* Vide Memorandum B.

21. In explaining the cause of excess in laminating,\* the method of measuring the amount of this addition to the weight of the scissel is explained; and it is sufficient here to say that, when ingots of one inch thickness are used, and three times annealed, the increase of weight and corresponding loss in melting is about  $36\frac{1}{2}$  tolas per lac of the scissel, defective coins, &c., returned, counting 37 per lac for the former and 23 for the latter†, and as these generally in the aggregate are not far

Amount of dirt and oxygen attached to the scissel.

short of the weight of solid bullion melted or coins issued, we may, without much risk of error, assume  $36\frac{1}{2}$  tolas per lac of the coins

issued as a fair rate. When  $\frac{5}{8}$ th inch ingots, only twice annealed, are used, this item is reduced to about 30 tolas per lac, counting  $30\frac{1}{2}$  tolas per lac for the scissel, and 21 for the coins.‡

22. The third item it has not been in my power to submit to actual measurement, and it is questionable whether it would be practicable

Third cause of apparent waste has not been measured.

to do so; at all events, although it might perhaps be possible, the attempt would involve an amount of labour inminute assaying or

chemical analysis far beyond the time and attention which could be given by any person whose whole thoughts were not devoted to the subject.

23. But it is not at all difficult to estimate indirectly the quantity

May be indirectly estimated.

of base metal separated in melting, and by attending to the following remarks, the method

of doing so will, I trust, be easily understood.

24. Our first step is to examine the experience of all the Mints in reference to the quantity of extra alloy which has been found necessary, to correct and compensate the refinement of the metal during coinage.

Extra alloy must be ascertained.

We find the clearest and most instructive data on this point in the accounts of the Bombay

Mint, which, as before noticed, have been kept in a more satisfactory and precise manner than either of the other two.

25. In Calcutta, in consequence, probably, of the peculiar division of responsibilities and duties, between the Mint and Assay Masters, it is clear that the subject has not been rightly understood. At one time we find that no allowance was made for unreported fractions, and the Assay Master,

Calcutta practice as to extra alloy inquired into.

whose duty it is to order the extra alloy, appeared to think that he had fulfilled his part by covering the losses in melting the solid

\* Vide Memorandum D, paras 7 and 8.

† Vide Memorandum D, paras 14 and 15.

‡ Memorandum D, paras 10 and 11.

bullion,\* with part of which (*viz.*, dirt) the extra alloy has nothing to do, and making no compensation whatever for the refinement in melting the scissel. At a later date, we find compensation made for the unreported fractions (and late standard Rupees), but a gradually decreasing allowance of extra alloy; till in 1851-52 the latter totally ceases; although nothing can be more plain than that, if the mixture or alligation of the metals required for coinage be made precisely "standard" on first putting it into the pot, and afterwards parts with a large proportion of copper,† it must cease to be "standard," and therefore that the coins must necessarily vary from "standard" unless compensation be made.

26. On account of the great irregularity of practice here noticed, it is impossible to make any use of the experience of the Calcutta Mint, in respect to extra alloy, during the Second period; but its records during the First period, together with the experience of Bombay and Madras, will be found to furnish the required information.

27. In Bombay, the practice is to alligate the unreported fractions, so as to produce a mixture precisely "standard" including them, and in addition to put in a further allowance of one tola per mille, or 100 per lac of extra alloy, at the first melting, to compensate in part for the various refinements throughout the coinage; and subsequently to add such further quantity, from time to time, as the examination of the coins may be found to dictate.

28. In this way, as the accounts of copper for "extra alloy" and "unreported fractions" are kept separate, and as the additions are made by the Assay Master, who has no interest in the manipulation, except to see that the coins are "standard," the circumstances seem to be preclude the idea of any larger quantity of alloy being added than what is absolutely necessary to replace that lost in the various processes; the danger indeed being that the Assay Master would rather fall short of this, which seems to have been the case, the coins being above‡ "standard." We may therefore safely assume the quantities so added to be a moderate measure of the absolute loss of base metal during the coinage, and on referring to the accounts for the whole 12 years, we find it to have

Reasons for considering it trustworthy.

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\* Correspondence Indian Mints, page 76, para 37.

† In the Calcutta Mint during the year 1852-53, the quantity of copper taken out of the coins in bleaching the blanks must have averaged 1,000 tolas a month; and as no compensation was made to meet this refinement, the State suffered a loss to that extent in this single item.

‡ Vide Appendix No. 17.



been at the rate of 123 tolas per lac of the coins issued,\* the copper put in besides this to compensate for unreported fractions being at the rate of 119 tolas per lac.

29. In Madras, during the Second period, which I take in preference to the whole, because the business of the department was conducted more regularly than our first operations, and the results also agree more closely with the experience in Bombay, the total amount of copper employed, under both heads, *viz.*, to cover “unreported fractions” and “additional alloy,” was at the rate of 250 tolas per lac. The difference of eight tolas per lac in excess of Bombay, may be explained, by the fact of the coins being issued a little below standard, while those from the Bombay Mint were a good deal above it.†

30. Assuming, then, that the unreported fractions were on the whole amount of bullion coined during the six years, about the same in Madras as Bombay, that is, at the average rate of 119 tolas per lac, and the whole quantity of extra copper put into the pot, at the rate of 250 tolas per lac, it will be observed that, of the 250 tolas of copper, that part which was employed in compensating the refinement or loss of base metals during the coinage, must have been at the rate of 131 tolas per lac of coins issued by the Mint.

31. As the above quantity of 131 tolas copper per lac of out-turn was put into the pot in excess of the true alligation, and yet the coins on issue, upon the closest examination, proved to be only eight tolas per lac below standard, it follows that the difference between the eight and 131 tolas, *viz.*, 123‡ tolas per lac, shows the quantity of base metal separated during coinage.

32. Now there are only two processes in which the base metal is so separated, melting, and bleaching. In the latter, it has been ascertained by frequent experiments, that when, in using  $\frac{5}{8}$ th inch ingots twice annealed, the total loss in bleaching Rupee blanks, comes to 74 Rupees

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\* Vide Appendix No. 6.

† According to the calculations made in Appendix No. 17, the Bombay coins for the whole period would appear to have been 5‡ tolas per lac above standard, but as these calculations are made on a very limited number of assays, measuring the coins by a different standard from that to which they were adjusted, it is perhaps safer to assume that by the *local* assay they were considered correct.

‡ It will be observed, that this rate agrees precisely with the experience in Bombay, and is within  $1\frac{1}{2}$  tolas per lac of that of Calcutta. Vide Report, para 28.

per lac, about tolas 54 thereof consists of copper separated ;\* when with 1-inch ingots, after a triple annealing, the total loss is about 89 tolas, 68 consist of copper. The practice of the Madras Mint, during the six

years under review, having been exclusively of the former kind, I shall confine myself to the facts afforded by it. Taking, therefore, Deduction of the quantity of copper separated by melting. the whole amount of base metal separated during coinage, as above shown, to be 123 tolas per lac, and deducting that part of it separated in bleaching, and which must have been about 43 tolas per lac (the total apparent loss being 59), the remainder 80 tolas shows the quantity of base metal separated by melting.

33. Out of this total quantity, of about 80 tolas, part separates during the melting of the alligation, and part by the melting of scissel. It is difficult to assign the exact quantities of each, as the refinement is very uncertain, varying with each description of bullion, and probably also with the scissel formed out of it ; and I can only conjecturally estimate 50 and 30 as the proportional losses. The measurements which I have made† of the latter, having given irregular results, and the highest falling short of 30 tolas per lac.

\* The following memorandum shows the results of the bleaching department for six separate months, on single Rupee blanks, cut from straps prepared from  $\frac{3}{4}$ th inch ingots.

Month.	Total apparent waste.		Weight of metallic copper recovered.	
	Tolas.	As.	Tolas.	As.
1853.				
October.....	395	6	266	8
November.....	503	7	407	6
December.....	473	2	334	8
1854.				
January.....	544	8	392	2•
February.....	558	5	407	4
March.....	492	5	359	8
	2,967	1	2,167	4

The total weight and value of the coins being 40 lacs very nearly (39,99,413) the average results are, total waste 74, and recovery of copper 54 tolas per lac.

Similar experiments on  $\frac{1}{4}$  and  $\frac{1}{2}$  Rupees, from  $\frac{3}{4}$  ingots give 130 and 106 for the former, and 160 and 112, very nearly, for the latter.

† The following is a description of the mode in which these measurements were made:—A selection was made of a pot of metal which had been melted more than once, and was supposed to be probably uniform in quality, and below standard (usually a melting of scissel reported  $W\frac{1}{2}$ ), and directions were given that it should be remelted with an unusual degree of attention to the stirring, the metal after fusion being granulated by pouring it into cold water.

A considerable number of the granules thus formed (generally from 30 to 50), were taken indiscriminately from the heap, and individually assayed by M. Gay Lussac's process, the solutions being graduated so as to show the fineness to 2 grs., and by estimating half the last indication, to the single grain in the troy pound. The average of the 30 or 50 assays was taken as the average fineness of the whole pot. When care had been taken in stirring the pot, during fusion, the fineness of the granules generally exhibited a close agreement, the instances being

34. The variety of loss upon first melting different descriptions of bullion in the Indian Mints, has been shown by Colonel Forbe's\* experiments, to range from 41 to 386 tolas per lac melted (the first rate would be 82 tolas per lac of out-turn by the Mint), but these rates apply when there has been little or no pre-melting. I think, therefore, the above deduction of 80 tolas per lac, as the measure of the total separation of base metal in melting for coinage (in comparison with the coins issued), is a higher rate than would be experienced, if the bullion had been pre-melted, and care taken to assist the separation of all volatile and easily oxidisable alloy.

35. Reasons have been stated in the body of the report† for the belief that the drosses left in this Mint, during the second period, contained more silver than they were supposed to do, and that, if properly assayed, the apparent waste, allowing for silver left in the dross, would not have exceeded 100 tolas per lac (50 tolas per lac of melting), and if we assume that to be the case when the drosses are exhausted; and it has been proved by later experience that it may be brought within that rate, it may be useful to compare the actual refinement in melting, just deduced, with the corresponding apparent waste after exhausting the drosses; which we may do by setting down the various items of apparent loss enumerated above, and after assigning to them their respective values, comparing the total with the rate of one hundred tolas per lac.

*Losses in melting bullion‡ and scissel from  $\frac{5}{8}$ th inch ingots.*

Table of apparent losses in melting—when $\frac{5}{8}$ th inch ingots are in use.	36. No. 1,	0	Dirt attached to pre-melted bars.
	„ 2,	30 tolas	{ Oxygen and dirt attached to scissel and defective coins, &c. &c.
	„ 3,	80 tolas	{ Separation of base metals from alligations and scissel.
	„ 4,		
	„ 5,	5 tolas	Silver left in the dross.

Total 115 tolas per lac of coins issued by the Mint, or  $57\frac{1}{2}$  per lac of melting.

37. No. 1, although estimated to cause an apparent loss of three tolas per lac, is not entered here, as the loss is compensated to the melter, as I have explained. No. 2 is entered according to our experience with

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rare in which it varied  $\frac{1}{2}$  dwt. from the mean of the whole; generally three-fourths of the granules were within  $\frac{1}{4}$  dwt. of the mean, and one-half of them within  $\frac{1}{2}$  dwt. of it.

The metal was now again melted, laminated, and cut into blanks and scissel, which were put into the pot and re-melted, and the operation was repeated a number of times, usually ten or twenty, after which the silver was again granulated, and the fineness ascertained in the same manner as at first. It is necessary in using these granules, to guard against their containing water, which they sometimes, though rarely, do.

\* Correspondence, Indian Mints, p. 76

† Paras 45 and 46.

‡ This table is corrected further on, in para 38.

$\frac{5}{8}$ th inch ingots.\* No. 5 cannot be measured, but is entered according to the best judgment we can form from occasional trials of the state of the

drosses, after exhaustion. The discrepancy exhibited by the table would tend to make it appear that the loss of base metals, or refinement, if it were possible, is *greater* than the apparent waste; but we must remember that the calculation of items, No. 3 and 4, is based on the assumption that the unreported fractions, during the second period, were on a par with the Bombay average. But it is possible they may have exceeded it, by the amount of the discrepancy, in which case the refinement in melting, deduced in the way followed in paras 30, 31, and 32, would be diminished to a corresponding extent; and if the whole discrepancy were thus accounted for, would become 65 tolas per lac, instead of 80; an explanation which would be more in accordance with the results of our later experience, given† in the Report, which show, by very careful observation, that the actual refinement in melting, during the 23rd Settlement, when there was a more than ordinary proportion of small scissel put into the pot, only amounted to  $49\frac{1}{2}$  tolas per lac.

38. The corrected table derived from the experience of the second period would therefore stand as follows:—

*Losses in melting bullion and scissel from  $\frac{5}{8}$ th inch ingots.*

	Tolas.		
	No. 1,	0	Dirt attached to pre-melted bars.
Corrected table of	„ 2,	30	Oxygen and dirt attached to the scissel.
losses with $\frac{5}{8}$ th ingots	„ 3,	65†	Separation of base metals, from alligations and scissel.
	„ 4,		
	„ 5,	5	Silver left in the drosses,
<hr/>			
100 Total apparent loss.			

39. The following table is based on the experience gained by the use of 1-inch ingots, but during a period when a larger proportion of small coins than usual in most Mints were under manufacture. It therefore cannot be applied to ordinary Mint practice without some slight modification, but it is useful, as a statement framed from actual experience on a large scale.§

Table of losses with 1-inch ingots in use.

\* Memorandum D, p. 10 and 11 Considering the scissel to be to the rejected coins in the ratio of about 40 to 1.

† Para 82, and Appendix No. 18.

‡ Perhaps 33 and 27 may represent, in some degree, the relative refinements of the alligations and scissel.

§ Vide Report para 82, and Appendix No. 18.



*Losses in melting bullion and scissel from 1-inch ingots.*

Rates per lac of coins

issued by the Mint.

No. 1,	0	Dirt attached to pre-melted bars.
„ 2,	45 tolas.	{ Oxygen and dirt attached to scissel and defective coins, &c. &c.
„ 3,	{ 49½	Refinement or copper separated from alligations and scissel.
„ 4,		
„ 5,	11*	Silver left in the dross.
Total..105½ tolas.		

40. The above is at the rate of about  $52\frac{3}{4}$  tolas per lac of the bullion melted. The Calcutta statement falls a trifle below this, being  $51\frac{3}{4}$  per lac, for the second period ( $103\frac{1}{2}$  on the out-turn), but there are two years (1849-50 and 1850-51), in which it seems probable that there may have been some unusual diminution of the apparent loss, which may perhaps be caused in the way pointed out by Captain Burke (vide his letter in the

Remarks on the table.

Appendix No. 12, para 3). At all events it appears very probable, that by more care in pre-melting, the separation of base metals may be diminished; which will reduce the apparent loss, but occasion no other benefit than improve the regularity and certainty of the meltings, for it is obvious any *real* loss may be prevented by additional alloy.

41. It is of importance here to show how it happens that no actual loss occurs in the melting department, if the silver left in the dross be allowed for. The compensation for item No. 1, has been already explained. No. 2, which is caused by oxygen and soot, added to the metal in the course of lamination (by annealing), is met and compensated by an excess of weight delivered by that department. Nos. 3 and 4, which are occasioned by separation of oxidisable base metal, are met and compensated by the “additional alloy” (together with compensation for the copper removed in bleaching). No. 5 alone remains, and that is allowed for.

42. It will have been gathered from the preceding remarks, that the rate per lac of apparent waste in melting, may be reduced by attention to three points, viz., 1st, Care in the pre-melting, to secure the separation of the volatile or easily oxidisable metals, 2nd, Care in assaying, to avoid needless re-alligations or re-meltings, and 3rd, Care in the

\* This amount was accidentally left more than it ought to be. It could have been easily reduced four or five tolas per lac. The weight of the drosses was about eight tons, after melting forty-two lacs of tolas (48 tons) of bullion.

recovery of the drosses. The first is desirable, in order to attain uniformity of practice; but it does not carry with it any improvement in the general result; because it is obvious that, in stopping the separation of base metals, we also put a stop to the necessity for, and power of, compensation by additional alloy.

43. The second precaution mentioned above is desirable chiefly to avoid expense, because, although the rate of apparent melting loss per mille of coins issued is, of course, increased by multiplying the mass of metal fused, yet, if all the apparent losses be met by the compensations

proper for them, there need not be any material waste of precious metal. The only one which appears really to take place is the third, or the silver left in the dross, after supposed exhaustion; and this may be estimated at a maximum, when proper means are used, at not more than the twenty or thirty thousandth part, and therefore need not be considered of much importance.

44. Under favourable circumstances, it appears to be certain that the apparent loss in melting silver may be reduced to less than a hundred tolas per lac of issues. It would appear, by examining the list given in paras 38 and 39, that if the further separation of base metal could be altogether prevented, the total apparent loss would be reduced to 35 tolas with  $\frac{5}{8}$ th inch ingots, and 50 tolas with 1-inch do, per lac of coins issued. So great a reduction as this is probably impracticable in ordinary work, but by careful

pre-melting much may be done. In the Royal Mint, the rate is 68 tolas per lac,\* upon the average of 10 years; so that if there were any important object to be gained, it would seem to be not impracticable to reduce the loss to 60 or 70 tolas per lac; but after what has been before said on this subject, it will be apparent, that the only benefit to be gained by the reduction is the improved regularity and certainty of the results.

45. Since the adoption of the system of a regular monthly recovery of drosses, the practice has been followed of making a cursory examination of them, by washing, before allowing them to leave the melting room; with the view of removing all the grosser particles, and every bit of silver which could attract the eye, and tempt speculation. In this way, the deliveries of the melting room (which furnishes a daily account,) generally show a balance against it, after deducting the particles abovementioned, of about 300 tolas per lac of meltings, or 600 per lac of

Objects gained by the precautions.

Apparent loss may be much reduced.

Ordinary routine in the melting department.

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\* Value of coins issued £33,29,716 and waste £2,272.

Mint out-turn ; which may be reduced, by recoveries in the dross room, to less than 50 tolas per lac of meltings, or 100 tolas per lac of coins issued by the Mint, as above stated.

46. It may be proper to explain, before concluding this Memorandum, that the empirical system of regulating the proportion of alloy, which is referred to in para 21 of the Report, merely consists of the addition of  $1\frac{1}{2}$  tolas per mille to every pot of "standard" melting, whether it be solid, or scissel ; and melting all  $W\frac{1}{2}$  scissel without any allowance of extra copper.

Empirical system of additional alloy.

47. By this course of proceeding, the metal, as it were, regulates itself, according to the assays ; and it will be observed, on reference to paras 28, 29, 30, and 31, and Statements 6 and 9,\* that while the amount of copper taken in by the silver agrees very closely with the corresponding quantities in Bombay, throughout the twelve years, the coins issued by this Mint, have been close to standard.

Remarks on the effects of the system.

48. I have only to add, that it appears to me very desirable, that the subject of the extraction of silver from the drosses should be closely studied, with the advantage of modern appliances, and European skill. Probably if this were done, the profitable extraction of the silver could be carried even farther than at present, and the process might be improved in simplicity and expedition.

European methods of recovering drosses should be studied.

## G.

### PIX EXAMINATION OF THE COINS.

1. The pix examination of the coins has an important use which seems to have been wholly lost sight of ; as it is generally done in a way that frustrates that object, more or less, in most Mints. I refer to the *valuation* of the coins issued by the Mint, an operation of which the accurate performance is obviously as necessary, as the correct valuation of the bullion delivered to it.

Important use of the pix assay lost sight of.

2. According to the practice followed in the Calcutta and Bombay Mints, the Assay Master usually examines the daily issue, by assaying a few pieces taken from it ; and if he is satisfied that they are within the prescribed "remedies," pronounces them all "standard ;" but no pains,

Practice in Calcutta and Bombay.

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\* Vide also separate Memorandum on Additional Alloy, para 15.



I believe, are taken to register how much the pieces are above or below the exact legal fineness, nor in what proportion the number of pieces above, may exceed those below, or *vice versâ*.

3. The consequence is, that the value of the whole deliveries may, and does fluctuate, very considerably, without notice. And it is absolutely impossible that the receipts and deliveries of the Mint can be strictly, or in fact, at all checked, when it is easy for large values of

Evils of the want of minute attention to the pix assays.

bullion to be passed in\* and out of it, without the knowledge of any one; which values, if we may judge by the pix examination of the coins of the Calcutta and Bombay Mints, (vide Appendices 16 and 17), may sometimes amount to 200 Rupees in every lac, and in an extreme case might, in Calcutta, involve a gain or loss of 60,000 Rupees.

4. What is required is, an exact valuation of the whole of the out-

Use to be made of them.

turn of the Mint, as correctly done as the valuation of its receipts; and this is quite easy.

It ought also to be made by the *same scale* as the receipts are measured by.

5. The importance of this does not need much elucidation. It would not be very remarkable if, in spite of the care of the Indian Assay Masters, there should be *slight* differences between their standards and that of the Royal Mint. This will be thought all the more likely when

Importance of this application of them.

it is remembered, that the present gold trial plate in use in the Royal Mint differs by at least three grains in the troy pound, from actual precision; and that it was thought useless to attempt to bring it nearer (vide Report of 1837, Appendix, p. 80, note). If we assume only that an occasional difference of three grains in the pound, more or less, should exist between the standards in India and England, this would create a difference in the valuation of the coins issued, of nearly 57 tolas to every lac; which, on a coinage of 250 lacs, would necessarily amount to more than 14,000 Rupees. Hence the valuation of the out-turn ought to be made by the *same* standard as that used to purchase the bullion; in which case, with proper care, there ought to be comparatively small variation. By doing this, we are enabled to make a comparison between the receipts and issues, and an efficient check can be established.

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\* When the stock of bullion in charge of the Mint is credited with a delivery of coins which contain a large amount of copper beyond the legal standard at which they are valued, the effect is the same, as if that amount of silver had been passed into the Mint, and added to the stock. When a delivery of coins is made, and the Mint is credited with less silver than is contained in the pieces, the effect is the same as if that amount had been taken from the stock, and passed out of the Mint.



6. Very little more trouble is required in making the examination of the out-turn of the Mint than is at present employed, it only requires that some important points should be attended to.

The application is easy.

7. First, the fineness of every piece assayed should be stated with as much precision as the fineness of bullion is, *viz.*, either to the dwt. and grain, as is done in Calcutta, or to the second decimal of the "touch," as in Bombay. Secondly, a proper number of pieces should be separately assayed, not less than ten daily for every Mint; double that number when the out-turn is very large, or irregular. Thirdly, the results thus obtained ought to be combined together, to give a true valuation of the out-turn.

Method to be observed.

8. Still further accuracy may be attained by attention to the following remarks, which suggest an alteration, occasioning no extra trouble whatever, and only the expense of a few pounds sterling.

Further accuracy may be attained.

9. All coins vary essentially in the fineness of their different parts, according to the position which they may have occupied in the strap whence they were cut. If we were to call those parts of the coins which lie in the direction of the length of the straps, north and south, and those at right angles thereto, east and west, it would give a correct idea of this peculiarity to say, that there is no essential difference in fineness between the north and south sides of the piece, but a considerable one between the east and west, frequently amounting to  $\frac{3}{4}$  dwt.; and in coins cut from certain portions of each strap, to more than 1 dwt., sometimes nearly 2 dwts. From this circumstance, it is evident, that assays taken in the usual manner, by flattening one edge of a coin, and cutting off a part of it, may often lead to its unjust condemnation; and when the work of a Mint is liable to rejection in consequence of the unfavorable assay of a single coin, which has more than once happened in Madras, it is indispensable that its true *average* fineness should be ascertained.

Details of this improvement.

10. This could be conveniently done if the assay office were furnished with an instrument mounting a series of half a dozen cutters, so arranged as to size, that they should successively cut portions out of the centre, and by concentric rings, each equal to the assay pound. Every one of these would represent the average fineness of the piece, and as the expense of such an instrument would be very moderate, it would be most desirable that the superior accuracy which would be obtained by the use of it, should be purchased at so cheap a rate.

Apparatus required.

11. The proper number of assays to be made of pix coins, has never yet been determined by any fixed principle, that I am aware of. I

Number of assays necessary  
to be made.

have therefore taken some pains to ascertain to what extent the accuracy of the valuation of a large issue of coins is affected by the number of assays, and from the few examples which I have been enabled to test, it appears that very close accordance in the results requires, not only that there should be numerous assays, in proportion to the number of pieces to be valued, but also a considerable number altogether. In other words, a small coinage would appear to require a larger proportionate number of assays than a large one, supposing the pieces in both cases to be equally regular and close to standard; but the necessity for a large proportion of assays is increased by irregularity in the coins.

12. When the coins are very generally correct, and but a few deviate from standard as much as 1 dwt., it appears probable that the assay of one piece in every ten thousand, would be quite sufficient to give a valuation very near to the truth. When a considerable irregularity generally exists, five or even ten times that

The number required under  
varied circumstances.

number would be necessary. I have suggested not less than ten assays daily, because, if there be an annual settlement of the Mint accounts, and valuation of its issues, this number would give at least 2,500 assays; and with such a number, supposing the coinage represented by them to be in the proportion of 2,000 to 10,000 tolas for each assay, and generally close to standard, we might expect the results of any number of different series of assays of the same issue, taken indiscriminately, would not differ from the mean of the whole more than from one to five tolas per lac.

13. It must be observed, that the standard by which the bullion is purchased, and the coins valued, might be very incorrect, and yet nevertheless the check, as to the accuracy of the work of the Mint, and the completeness of its deliveries, would not be in the least disturbed

Remarks on the preference to  
be given to the local assay.

thereby. If we suppose, as an extreme case, that it was 2 dwts. wrong, still, as the bullion would be valued and mixed by that scale, and the coins rated by the same, the receipts and deliveries of the Mint would not be in the least affected by the circumstance; the valuation of the coins would be precise, in reference to the scale employed in purchasing and debiting the bullion against the department. It is true the coins would be incorrect, and be either "better" or "worse," at the expense, or to the profit of the Merchants; and this would in the end appear, when the trials at the Royal Mint became known.

14. From the above consideration, it appears to be advisable that the transactions of the Mint should be completed by the assay on the spot, and that the Royal Mint assays, which are reported only once annually, should be confined to testing the accuracy of the standard or scale by which the local examinations are made. It cannot do more than this, because the number of pieces assayed at the Royal Mint is far too small to found thereon any valuation of the Mint issues, or even a *precise* judgment of the standarding of the coins; but it is very important and useful as a check upon their general accuracy; and even for that purpose it would be extremely desirable that the results of the examination of each year's coinage should be communicated within the earlier part of that following, if practicable.

15. In conclusion, I would beg to observe, that if, in practice it should accidentally occur, that any slight adjustment influencing the Standard should become necessary, it is of the greatest importance, in reference to the debit and credit in the Mint accounts, that the alteration should apply *first* to the bullion, and *afterwards* only to the coins manufactured therefrom. To value the issues by a scale different from that previously used on receipt, necessarily creates a variation of the accounts, which defeats accuracy. And it is surprising, how great is the influence of even trifling changes upon the large transactions of a Mint.

16. For instance, supposing the stock of bullion in charge of the Mint is of the value of one crore of Rupees, a change in the working standard of only three grains would, if applied to all the assays of coins manufactured from that bullion, make a difference of more than 5,500 Rupees, one way or the other. To avoid this, any necessary slight adjustment of the working standard should be applied to the bullion assays alone, till at least a crore in value of coins had been assayed, and then applied to both bullion and coins.

17. To provide against discrepancies arising from causes similar to the above, it is desirable that the bullion should be assayed by an officer of the Mint, as well as by the Assay Master, if anything like *strict* responsibility be required as to the receipts and deliveries.



## H.

## MILLING, BLEACHING, AND STAMPING.

The following few remarks concerning the milling, annealing, bleaching, and stamping departments, I have thought it desirable to insert, although they are not essentially connected with any of the arguments contained in the report; because it appears to me that they will throw a light upon the statement of our practice contained in Memorandums D and F; and, put into an easily accessible form, may perhaps be useful as data for future reference.

The four operations abovementioned are carried on usually in one department in Madras, and there is no division of responsibility; so that it is not possible to collect data respecting their separate results, except by arrangements specially made for that purpose; and the following are the results of a month's work, as to the recoveries from the dross, carefully noted in each.

The number of pieces executed during the month, (September 1853) was 7,36,000, weighing 7,36,570, and the difference of weight between the stamped coins and the blanks as received from the laminating and cutting departments, 613 tolas. Of this, 139 tolas weight of silver was afterwards recovered from the drosses, as will be detailed presently; thus leaving the apparent waste after the recovery 474 tolas ( $64\frac{1}{3}$  per lac) of which, according to experiment, about 43 per lac usually consist of copper separated, and 21 per lac of oxygen and dirt attached to the blanks,\* these two items would thus have amounted to 471 tolas, which is a trifle less than the apparent waste. The silver was recovered as follows:—

From the barrel in which the blanks are cleaned with paddy husk and water,† by collecting the sediment and burning the paddy husk.

	Tolas.	As.
1st recovery .....	106	13
2nd do. ....	8	6
3rd do. ....	1	11
Total...	116	14

\* Vide Memorandum F, para 32, and Memorandum D, para 10. It is this apparent waste after recovery from the drosses which is there referred to.

† Vide Memorandum on waste in coinage, para 32. Observations on Mints, and Professional Papers of the Madras Engineers, Vol. 2.



From the saw-dust used to dry the blanks.

	Tolas.	As.
1st recovery.....	9	13
2nd do. ....	3	7
3rd do. ....	2	5
Total..	15	9

From the sweepings of the milling, bleaching, and stamping rooms silver was recovered as follows:—

	Tolas.	As.
1st recovery.....	5	10
2nd do. ....	0	12
3rd do. ....	0	2
Total..	6	8

From these memorandums, it appears, that the first process, which is peculiar to Madras, caused a removal of silver from the blanks, during the month whose results were examined, at the rate of about 16 tolas per lac, and that about 3 tolas per lac were buried in the saw-dust used to dry the pieces, and in the general sweeping of the rooms. Of course, it is almost needless to remark, that the proportion of silver which may be removed, either by the cleaning barrel, or by the saw-dust, is regulated by the amount of force used in connection with these agents, and the length of time the coins are subjected to them.

The ingots, which were in use at the time the above results were noted, were  $\frac{5}{8}$ th inch in thickness.



## APPENDIX No. 1.

*Statement showing the Out-turn Value of the Silver Metal worked, and the Losses and Gains thereupon, in the Calcutta, Bombay, and Madras Mints from 1841-42 to 1852-53.*

YEARS.	CALCUTTA.						BOMBAY.						MADRAS.																								
	Losses Stated.			Gains Stated.			Outturn Value.			Losses Stated.			Gains Stated.			Outturn Value.			Losses Stated.			Gains Stated.			Outturn Value.												
	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.	Tolas.	A. P.											
1841-42	17,411	7 3	0 0	0 0	251,26,312	8 0	23,713	15 6	0 0	0 0	51,75,329	0 0	0 0	2,473	13 7	25,85,977	12 0	1842-43	42,567	14 8	0 0	0 0	206,11,864	4 0	27,390	11 2	0 0	0 0	107,95,668	0 0	0 0	1,104	11 7	0 0	0 0	16,40,203	2 0
1843-44	39,370	1 0	0 0	0 0	216,66,075	8 0	45,550	12 0	0 0	0 0	207,32,496	9 3	0 0	222	8 7	42,38,458	15 0	1844-45	42,399	4 3	0 0	0 0	283,35,602	4 0	37,782	11 8	0 0	0 0	154,60,180	2 0	0 0	1,829	8 1 <sup>3</sup>	31,72,429	11 0		
1845-46	30,660	3 1	0 0	0 0	225,32,332	8 0	5,804	5 3	0 0	0 0	136,60,807	0 0	0 0	2,233	6 9	22,32,280	11 0	1846-47	45,362	10 1	0 0	0 0	164,78,122	6 0	6,087	7 2	0 0	0 0	66,46,955	12 0	0 0	5,298	1 11 <sup>3</sup>	60,84,016	2 0		
Total..	2,17,771	8 4	0 0	0 0	1,348,50,309	6 0	1,40,242	7 7	6,087	7 2	724,71,436	7 3	1,104	11 7	12,037	7 0 <sup>1</sup>	199,43,366	5 0	1847-48	0 0	0 0	11,892	8 10	101,19,937	10 0	0 0	5,912	8 4	42,07,359	4 0	0 0	2,182	7 3	34,95,300	12 0		
1848-49	0 0	0 0	3,341	1 1	193,03,269	8 0	0 0	0 0	10,135	1 3	111,92,700	13 5	0 0	683	13 6	12,96,676	3 0	1849-50	0 0	0 0	4,520	5 5	135,97,117	0 0	7,614	5 3	0 0	0 0	96,50,554	7 2	0 0	697	2 8	8,64,371	15 0		
1850-51	7,565	12 6	0 0	0 0	121,31,096	12 0	0 0	0 0	15,309	0 7	120,78,306	1 10	0 0	1,842	2 9	19,54,271	0 0	1851-52	20,108	2 0	0 0	0 0	178,80,190	14 0	2,921	1 3	0 0	0 0	208,97,949	6 1	0 0	3,318	12 4	36,27,081	9 0		
1852-53	30,284	14 7	0 0	0 0	273,66,206	6 0	0 0	0 0	1,721	0 7	237,98,470	12 0	0 0	7,484	0 9	39,35,171	5 0	Total..	57,958	13 1	19,753	15 4	943,97,818	2 0	10,535	6 6	63,077	10 9	818,25,940	12 6	0 0	16,208	7 3	151,72,872	12 0		
Grand Total	2,75,730	5 5	5,19,753	15 4	4,292,48,127	8 0	1,50,777	14 1	39,165	1 11	1,542,97,377	3 9	1,104	11 7	723,265	14 3	351,16,239	1 0																			





## APPENDIX No. 3.

*St atement, shewing the Gains in the Calcutta Mint, and the rates per lac of the Coins issued; for the twelve years from 1841-42 to 1852-53.*

YEARS.	GAINS.										Total Gains per lac of Coins issued.				
	Unreported Fractions.			Late Standard Rupees.			Additional Alloy.			Sundry.		Total Amount of Gains.	Value of Coins issued.	Tolas.	
	Rate per lac of Coins issued.		Tolas.	Rate per lac of Coins issued.		Tolas.	Rate per lac of Coins issued.		Tolas.	Rate per lac of Coins issued.					
	Amount.	Tolas.		Amount.	Tolas.		Amount.	Tolas.							
1841-42 ... ..	0	0	29,538	117½	59,623	237½	787	3	89,948	251,26,313	358				
1842-43... ..	0	0	17,450	84½	27,835	135	3,439	16½	48,754	206,11,864	236½				
1843-44 ... ..	0	0	28,667	131½	27,355	161½	895	4	64,684	217,66,076	297				
1844-45... ..	0	0	42,374	149½	57,961	204½	639	21½	100,974	283,35,602	356½				
1845-46 ... ..	0	0	34,380	152½	31,227	138½	1,989	8½	67,596	225,32,332	299½				
1846-47... ..	2,102	13	13,627	82½	28,514	173	1,869	11½	46,112	164,78,122	279½				
Average first 6 years.	2,102	1½	1,66,036	123	240,282	178	9,648	7	4,18,068	1,348,50,309	310				
1847-48 ... ..	2,854	28½	21,163	209	12,566	124	323	3½	36,906	101,19,938	364½				
1848-49... ..	25,512	191½	6,234	46½	14,757	111	2	0	46,505	133,03,269	349½				
1849-50 ... ..	26,920	198	0	0	9,160	67½	145	1	36,225	135,97,117	266½				
1850-51... ..	28,605	235½	0	0	3,423	28½	71	0½	32,099	121,31,097	264½				
1851-52 ... ..	27,959	156½	0	0	0	0	200	1½	28,159	178,80,191	157½				
1852-53... ..	34,706	126½	0	0	0	0	400	1½	35,106	273,66,206	128				
Average last 6 years.	1,46,556	155½	27,397	29	39,906	42½	1,141	1½	2,15,000	943,97,818	227½				
Total & Genl. Average.	1,48,658	64½	1,93,433	84½	2,80,188	122½	10,789	4½	6,33,068	2,292,48,127	276				

## APPENDIX No. 4.

Statement, shewing the operative Losses in the various departments of the Calcutta Mint, and the rates per lac of the Coins issued; for the twelve years from 1841-42 to 1852-53.

YEARS.	Melting Department.			Laminating, Adjusting and Picking Departments.			Milling, Bleaching and Stamping Departments.			SUNDRY LOSSES.		NET FINAL RESULT.		
	LOSSES.			LOSSES DEDUCTING EXCESS.			LOSSES.			Amount	Rate per lac of Coins issued.	Total Losses.	Value of Coins issued.	Rate per lac of Coins issued.
	Amount.	Tolas.	Rate per lac of Coins issued.	Amount.	Tolas.	Rate per lac of Coins issued.	Amount.	Tolas.	Rate per lac of Coins issued.					
1841-42 ... ..	64,526	256 $\frac{3}{4}$	74	9,013	35 $\frac{1}{2}$	74	18,594	74	91	2,357	91	94,490	251,26,313	376
1842-43... ..	58,647	284 $\frac{1}{2}$	73 $\frac{1}{2}$	7,373	35 $\frac{1}{4}$	73 $\frac{1}{2}$	16,147	78 $\frac{1}{4}$	43	905	43	83,072	206,11,864	403
1843-44 ... ..	65,494	300 $\frac{3}{4}$	73 $\frac{1}{4}$	7,355	33 $\frac{1}{4}$	73 $\frac{1}{4}$	16,045	73 $\frac{1}{4}$	44	928	44	89,822	217,66,076	412 $\frac{1}{2}$
1844-45... ..	93,696	330	82 $\frac{1}{2}$	10,469	37	82 $\frac{1}{2}$	23,309	82 $\frac{1}{2}$	45	1,451	45	1,28,925	283,35,602	454
1845-46 ... ..	54,394	241 $\frac{1}{4}$	68 $\frac{1}{2}$	6,557	29 $\frac{1}{2}$	68 $\frac{1}{2}$	15,517	68 $\frac{1}{2}$	11 $\frac{1}{2}$	372	11 $\frac{1}{2}$	76,940	225,32,332	341
1846-47... ..	46,558	282 $\frac{1}{2}$	81 $\frac{1}{2}$	5,854	35 $\frac{1}{2}$	81 $\frac{1}{2}$	13,466	81 $\frac{1}{2}$	1 $\frac{1}{2}$	311	1 $\frac{1}{2}$	66,189	164,78,122	401 $\frac{1}{2}$
Average first 6 years.	383,315	284 $\frac{1}{2}$	76 $\frac{1}{2}$	46,721	34 $\frac{1}{2}$	76 $\frac{1}{2}$	103,078	76 $\frac{1}{2}$	4 $\frac{1}{2}$	6,324	4 $\frac{1}{2}$	5,39,438	1,348,50,309	400
1847-48 ... ..	14,506	143 $\frac{1}{4}$	72	*783	7 $\frac{1}{2}$	65 $\frac{1}{2}$	6,672	65 $\frac{1}{2}$	4	413	4	20,808	101,19,938	205 $\frac{1}{2}$
1848-49... ..	14,727	110	78 $\frac{1}{2}$	*2,282	17	78 $\frac{1}{2}$	10,483	78 $\frac{1}{2}$	2	275	2	23,203	133,03,269	174 $\frac{1}{4}$
1849-50 ... ..	9,107	66 $\frac{1}{4}$	80 $\frac{1}{4}$	*627	4 $\frac{1}{2}$	80 $\frac{1}{4}$	10,921	80 $\frac{1}{4}$	1 $\frac{1}{2}$	266	1 $\frac{1}{2}$	19,667	135,97,117	144 $\frac{1}{2}$
1850-51... ..	8,767	72 $\frac{1}{4}$	64 $\frac{1}{4}$	449	3 $\frac{1}{4}$	64 $\frac{1}{4}$	7,787	64 $\frac{1}{4}$	6 $\frac{1}{4}$	766	6 $\frac{1}{4}$	17,769	121,31,097	146 $\frac{1}{4}$
1851-52 ... ..	21,959	122 $\frac{1}{2}$	67	698	3 $\frac{1}{2}$	67	11,991	67	2 $\frac{1}{2}$	438	2 $\frac{1}{2}$	55,086	178,80,191	196
1852-53... ..	28,560	104 $\frac{1}{2}$	67	861	3	67	18,374	67	4	1,113	4	48,908	273,66,206	178 $\frac{1}{2}$
Average last 6 years.	97,626	103 $\frac{1}{2}$	70	*1,684	1 $\frac{1}{2}$	70	66,228	70	3 $\frac{1}{2}$	3,271	3 $\frac{1}{2}$	1,65,441	943,97,818	175 $\frac{1}{4}$
Total & Genl. Average.	4,80,941	209 $\frac{1}{2}$	74	48,729	21 $\frac{1}{4}$	74	1,69,306	74	4	9,595	4	7,04,879	2,222,48,127	307 $\frac{1}{2}$
Deduct Gains... ..	.....	.....		3,692	1 $\frac{1}{2}$									
Net Losses... ..	.....	.....		45,037	19 $\frac{3}{4}$									

\* Excess.

## APPENDIX No. 5.

*Statement showing the Net Results in the Various Departments of the Calcutta Mint, for the twelve years from 1841-42 to 1852-53.*

YEARS.	DIFFERENCE OR NET RESULTS.						REMARKS.	
	Gains by State-ment No. 3.	Losses by State-ment No. 4.	Gains.		Losses.			
			Amount.	Rate per lac of Coins issued.	Amount.	Rate per lac of Coins issued.		
	Tolas.	Tolas.	Tolas.	Tolas.	Tolas.	Tolas.	RS. A. P.	RS. A. P.
1841-42.....	89,948	94,490	0	0	4,542	18	Gains to the extent of	947 10 10 and Losses 13,816 7 2 stated in the accounts not included.
1842-43.....	48,754	83,072	0	0	34,318	166½	Gains do.	of 373 7 9 and Losses 8,623 12 10 do.
1843-44.....	64,684	89,822	0	0	25,138	115½	Gains do.	of 137 0 6 and Losses 14,368 12 2 do.
1844-45.....	1,00,974	1,28,925	0	0	27,951	98½	Gains do.	of 28 8 1 and Losses 14,476 7 11 do.
1845-46.....	67,596	76,940	0	0	9,344	41½	Gains do.	of 267 4 11 and Losses 21,523 5 5 do.
1846-47.....	46,112	66,189	0	0	20,077	121¾	Gains do.	of 230 9 7 and Losses 25,515 13 1 do.
Average for 1st 6 years.	4,18,068	5,39,438	0	0	1,21,370	90		1,924 9 8 98,324 10 7
1847-48.....	36,906	20,808	16,098	159	0	0	Gains do.	of 39 2 0 and Losses 4,244 7 2 do.
1848-49.....	46,505	23,203	23,302	175	0	0	Gains do.	of 456 6 7 and Losses 20,417 9 11 do.
1849-50.....	36,225	19,667	16,558	121¾	0	0	Gains do.	of 49 13 2 and Losses 12,087 5 0 do.
1850-51.....	32,099	17,769	14,330	118	0	0	Gains do.	of 49 5 6 and Losses 21,945 2 1 do.
1851-52.....	28,159	35,086	0	0	6,927	38¾	Gains do.	of 92 15 11 and Losses 13,273 7 3 do.
1852-53.....	35,106	48,908	0	0	13,802	50¼	Gains do.	of 1,096 4 0 and Losses 17,580 3 10 do.
Average for last 6 years.	2,15,000	1,65,441	70,288	75	20,729	22		1,783 15 2 89,548 3 3
Total & Genl. Average...	6,33,068	7,04,879	70,288	*30½	1,42,099	*62	* Rate per lac on Total issues, viz. 2,292,48,127-8-0.	
Deduct Gains.	.....	.....	.....	.....	70,288	30½		
Net Losses...	.....	.....	.....	.....	71,811	31½		

## APPENDIX No. 6.

*Statement shewing the Gains in the Bombay Mint, and the rates per lac of the Coins issued; for the twelve Years from 1841-42 to 1852-53.*

YEARS.	GAINS.						
	Unreported Fractions.		Additional Alloy.		Sundry.		Total Gains per lac of Coins issued.
	Amount.	Rate per lac of Coins issued.	Amount.	Rate per lac of Coins issued.	Amount.	Rate per lac of Coins issued.	
1841-42 ... ..	Tolas. 5,968	Tolas. 115	Tolas. 4,363	Tolas. 84	Tolas. 113	Tolas. 2	Tolas. 201
1842-43 ... ..	16,010	148	16,459	152	0	0	51,75,329
1843-44 ... ..	25,089	121	26,152	126	365	1	107,95,668
1844-45 ... ..	19,672	127	22,412	145	305	1	207,32,497
1845-46 ... ..	7,786	57	9,465	69	0	0	154,60,180
1846-47 ... ..	5,448	81 $\frac{3}{4}$	8,714	130 $\frac{3}{4}$	3,704	55 $\frac{1}{4}$	136,60,807
Average first 6 years.	79,973	110 $\frac{1}{4}$	87,565	120 $\frac{3}{4}$	4,487	6	66,46,956
1847-48 ... ..	4,366	103 $\frac{3}{4}$	5,504	131	1,630	38	724,71,437
1848-49 ... ..	16,828	150	13,903	124	0	0	42,07,359
1849-50 ... ..	10,421	107 $\frac{3}{4}$	11,566	119 $\frac{3}{4}$	0	0	111,92,701
1850-51 ... ..	20,406	168 $\frac{1}{2}$	18,040	149	0	0	96,50,554
1851-52 ... ..	23,421	112	26,681	128	183	0	120,78,906
1852-53 ... ..	29,180	122	26,999	111	1,333	5	208,97,949
Average last 6 years.	104,622	127 $\frac{1}{2}$	1,01,993	124 $\frac{1}{2}$	3,146	4	237,98,471
Total & Genl. Average.	1,84,595	119	1,89,558	123	7,633	5	818,25,940
							1542,97,377
							247



## APPENDIX No. 7.

*Statement shewing the operative losses in the various departments of the Bombay Mint and the rates per Lac of the Coins issued; for the twelve years from 1841-42 to 1852-53.*

YEARS.	Melting Department.			Laminating Department.			Cutting, Milling and Stamping Departments.			SUNDRY LOSSES.			NET FINAL LOSSE.		
	LOSSES.			LOSSES.			LOSSES.								
	Amount.	Rate per lac of Coins issued.	Tolas.	Amount.	Rate per lac of Coins issued.	Tolas.	Amount.	Rate per lac of Coins issued.	Tolas.	Amount.	Rate per lac of Coins issued.	Tolas.	Total Loss.	Value of Coins issued.	Rate per lac of Coins issued.
1841-42 ... ..	16,493	318	626	12	4,134	80	293	5	21,547	51,75,329	415	21,547	51,75,329	415	
1842-43 ... ..	47,105	436	2,814	26	11,361	105	669	6	61,949	107,95,668	573	61,949	107,95,668	573	
1843-44 ... ..	75,969	366	3,213	15	22,449	108	1,702	8	1,03,333	207,32,497	497	1,03,333	207,32,497	497	
1844-45 ... ..	60,612	392	2,091	13	15,124	97	1,975	12	79,892	154,60,180	514	79,892	154,60,180	514	
1845-46 ... ..	12,701	93	824	6	10,308	75	780	5	24,612	136,60,807	179	24,612	136,60,807	179	
1846-47 ... ..	None	0	618	9	2,160	32	40	0½	2,818	66,46,956	41½	2,818	66,46,956	41½	
Average first 6 years.	2,12,880	293½	10,186	14	65,536	90½	5,459	7½	2,94,061	724,71,437	405½	2,94,061	724,71,437	405½	
1847-48 ... ..	None	0	343	8	2,675	63½	474	11	3,492	42,07,359	82½	3,492	42,07,359	82½	
1848-49 ... ..	20,479	183	903	8	4,852	43	141	1	26,375	111,92,701	235	26,375	111,92,701	235	
1849-50 ... ..	22,804	236	799	8	5,529	57	160	1½	29,293	96,50,554	302½	29,293	96,50,554	302½	
1850-51 ... ..	18,121	150	1,017	8¼	3,885	31¾	109	0½	23,132	120,78,906	190½	23,132	120,78,906	190½	
1851-52 ... ..	36,822	176	1,345	6¼	13,482	64	957	4½	52,605	108,97,949	250½	52,605	108,97,949	250½	
1852-53 ... ..	44,241	185½	2,254	9¼	7,397	30½	966	3½	54,859	237,98,471	229	54,859	237,98,471	229	
Average last 6 years.....	1,42,467	174	6,661	8	37,820	46	2,807	4	1,89,756	818,25,940	232	1,89,756	818,25,940	232	
Total and General average....	3,55,348	230½	16,847	10½	1,03,356	67	8,266	5½	4,83,817	1542,97,377	313	4,83,817	1542,97,377	313	

APPENDIX No. 8.  
Statement shewing the Net Results of Coinage in the Bombay Mint, for the twelve years from 1841-42 to 1852-53.

YEARS.	DIFFERENCE OR NET RESULTS.				REMARKS.			
	Gains.		Losses.					
	Amount.	Rate per lac of Coins issued.	Amount.	Rate per lac of Coins issued.				
Gains by State-ment No. 6.	Tolas.	Tolas.	Tolas.	Tolas.	TOLAS A. P.	TOLAS A. P.		
1841-42.....	10,444	21,547	0	11,103	Gains to the extent of 2,332 5 3 and Losses 14,943 11 3 stated in the accounts not included.			
1842-43.....	32,470	61,949	0	29,479	Gains do. of 4,732 8 0 and Losses 2,043 5 1 do.			
1843-44.....	51,606	1,03,333	0	51,727	Gains do. of 8,133 3 2 and Losses 1,957 11 5 do.			
1844-45.....	42,389	79,802	0	37,413	Losses do. of ..... 369 2 7 do.			
1845-46.....	17,251	24,612	0	7,361	Gains do. of 1,556 10 11 .....do.			
1846-47.....	17,866	2,818	226½	0	Gains do. of 506 0 0 and Losses 9,465 11 11 do.			
Average first 6 years.....	1,72,026	2,94,061	15,048	1,37,083	17,260 11 4	29,379 10 3		
1847-48.....	11,500	3,492	8,008	0	Losses do. of ..... 2,095 9 11 do.			
1848-49.....	30,731	26,375	4,356	0	Gains do. of 3,778 12 0 .....do.			
1849-50.....	21,977	20,293	0	7,306	Losses do. of ..... 309 0 0 do.			
1850-51.....	38,446	23,132	15,314	0	Losses do. of ..... 5 0 0 do.			
1851-52.....	50,285	52,605	0	2,320	Losses do. of ..... 601 10 8 do.			
1852-53.....	56,812	54,859	1,952	0	Losses do. of ..... 430 15 4 do.			
Average last 6 years.....	2,09,761	1,89,756	29,630	9,625	5,773 12 0	3,242 3 11		
Total and Genl. Average.....	2,31,787	4,83,817	44,678	1,46,708				
Deduct Gains.....	.....	.....	.....	44,678				
Net Losses.....	.....	.....	.....	1,02,030				

\* Rate per lac on Total issues viz. 1542,97,377.

\* Rate per lac on Total issues viz. 154,297,377.

## APPENDIX No. 9.

*Statement shewing the Gains in the Madras Mint, and the rates per lac of the Coins issued; for the twelve years from 1841-42 to 1852-53.*

YEARS.	GAINS.				Total Amount of Gains.	Value of Coins issued.	Total Gains per lac of Coins issued.
	Unreported Fractions and Additonal Alloy.		Sundry.				
	Amount.	Rate per lac of Coins issued.	Amount.	Rate per lac of Coins issued.			
	Tolas.		Tolas.		Tolas.		Tolas.
1841-42.....	9,801	379	91	3	9,892	25,85,978	382
1842-43.....	4,326	263	108	7	4,434	16,40,203	270
1843-44.....	12,973	306	126	3	13,099	42,28,459	309
1844-45.....	7,562	238	90	3	7,652	31,72,429	241
1845-46.....	7,174	327	129	6	7,303	22,32,281	327
1846-47.....	13,860	221	122	2	13,982	60,84,016	229
Average first 6 years.....	55,696	279	*666	3	56,362	199,43,366	282
1847-48.....	7,712	220	113	3	7,825	34,95,301	223
1848-49.....	2,697	208	96	7	2,793	12,96,676	215
1849-50.....	1,950	226	81	9	2,031	8,64,372	235
1850-51.....	5,561	285	752	38	6,313	19,54,271	323
1851-52.....	10,046	277	594	16	10,640	36,27,082	293
1852-53.....	9,932	252	1,356	34	11,288	39,35,171	286
Average last 6 years.....	37,898	250	†2,992	19	40,890	151,72,873	269
Total and Genl. Average.	93,594	266	‡3,658	10	97,252	351,16,239	276

\* Including recoveries in the Bullion, or premelting department, to the amount of 631-9-11½.

† Including recoveries in the Bullion, or premelting department, to the amount of 2,967-14-6¼.

‡ Including recoveries in the Bullion, or premelting department, to the amount of 3,599-8-6.

## APPENDIX No. 10.

Statement shewing the operative Losses in the various departments of the Madras Mint, and the rates per lac of the Coins issued; for the twelve years from 1841-42 to 1852-53.

YEARS.	Melting Department.			Laminating Department.			Milling Bleaching and Stamping Departments.			SUNDRY LOSSES.		NET FINAL RESULT.					
	LOSSES.			EXCESS.			LOSSES.					Loss after deducting Excess.		Value of Coins issued.		Rate per lac of Coins issued after deducting Excess.	
	Amount.	Rate per lac of Coins issued.	Tolas.	Amount.	Rate per lac of Coins issued.	Tolas.	Amount.	Rate per lac of Coins issued.	Tolas.	Amount.	Rate per lac of Coins issued.	Tolas.	Tolas.	Tolas.	Tolas.	Tolas.	Tolas.
1841-42 ... ..	9,562	369	106	2,763	106	826	31	31	0	0	7,625	25,85,978	294				
1842-43 ... ..	4,208	256	22	372	22	1,70	103	103	7	7	5,544	16,40,203	337				
1843-44 ... ..	11,062	262	22	937	22	2,988	70	70	0	0	13,113	42,28,459	310				
1844-45 ... ..	4,281	135	34	1,089	34	2,131	66	66	12	0	5,335	31,72,429	167				
1845-46 ... ..	3,695	165	15	351	15	1,784	79	79	7	0	5,135	22,32,281	229				
1846-47 ... ..	6,242	102	31	1,951	31	3,522	57	57	7	0	7,820	60,84,016	128				
Average first 6 years.	39,050	195	37	7,463	37	12,952	65	65	33	0	44,572	199,43,366	223				
1847-48 ... ..	3,638	104	16	572	16	2,590	74	74	0	0	5,686	34,95,301	162				
1848-49 ... ..	1,388	107	0	0	0	753	58	58	0	0	2,141	12,96,676	165				
1849-50 ... ..	914	106	* 1	* 11	* 1	431	49	49	0	0	1,356	8,64,372	156				
1850-51 ... ..	3,417	174	1	24	1	1,150	59	59	0	0	4,543	19,54,271	232				
1851-52 ... ..	5,849	161	2	73	2	2,102	58	58	28	0	7,906	36,27,082	217				
1852-52 ... ..	4,532	115	37	1,470	37	1,969	50	50	0	0	5,031	39,35,171	128				
Average last 6 years.	19,768	130	14	2,128	14	8,995	59	59	28	0	26,663	151,72,873	175				
Total and General average.	58,818	167	27	9,602	27	21,947	62	62	61	0	71,235	351,16,239	202				
Deduct Loss.....	.....	.....	0	11	0	.....	.....	.....	.....	.....	.....	.....	.....				
Net Gain.....	.....	.....	27	9,591	27	.....	.....	.....	.....	.....	.....	.....	.....				

\* Loss.



## APPENDIX No. 11.

Statement shewing the Net results of Coinage in the Madras Mint, for the twelve years from 1841-42 to 1852-53.

YEARS.	Gains by State- ment No. 9.	Losses by State- ment No. 10.	DIFFERENCE OR NET RESULTS.				REMARKS.
			Gains.		Losses.		
			Amount.	Rate per lac of Coins issued.	Amount.	Rate per lac of Coins issued.	
	Tolas.	Tolas.	Tolas.	Tolas.	Tolas.	Tolas.	
1841-42 ... ..	9,892	7,625	2,267	87	0	0	0 Silver dross value as per Assay Master's Report 206 15 1 not included.
1842-43 .. .. .	4,434	5,544	0	0	1,110	67	0 Do. do. do. 240 12 0 and wastage of 235 8 1½ in Silver Refining Room not included.
1843-44 .. .. .	13,099	13,113	0	0	14	0	0 Silver dross value as per Assay Master's Report 274 1 5 do. of 37 8 7½ in Silver Refining Room not included.
1844-45 .. .. .	7,652	5,335	2,317	73	0	0	0 Silver dross value as per Assay Master's Report 97 10 8 do. of 585 5 3½ of Silver Alloy in Gold Refining Room not included.
1845-46 .. .. .	7,303	5,135	2,168	97	0	0	0 The value of the drosses as per Assay Master's Report was 78 7 11 and this sum together with 11 8 2 for which they were sold beyond their value is included in the settlement returns, but not included here, also wastage of 24 0 0½ of Silver Alloy, in Gold Refining Room, not included.
1846-47 .. .. .	13,982	7,920	6,102	101	0	0	0 Silver dross value as per Assay Master's Report 349 11 7 not included. Silver reco- vered from specimens of dross, valued by Assay Master 2 Pice, was not included in the settlement Returns, and wastage of 254 5 9½ in Silver Refining Room, and 953 2 8 of Silver Alloy, in Gold Refining Room, not included.
Average first 6 years..	56,362	44,572	12,914	64	1,124	5	0 Total value of drosses of Coining de- partments, for the 1st period, - 907 3 6 Do. of Refining Room, 213 1 9 Do. of Bullion or pre- melting Room, - - 121 5 5 Total Losses not included - 334 7 2 Excess in Bullion or pre-melting room, 631 9 11½ Total value of drosses of the 1st period 1,241 10 8
1847-48 .. .. .	7,825	5,686	2,139	61	0	0	0 Silver dross value as per Assay Master's Report 94 13 10 and wastage of 51 12 0½ of Silver Alloy in Gold Refining Room, not included.
1848-49 .. .. .	2,793	2,141	652	50	0	0	0 Silver dross value as per Assay Master's Report 31 9 2 not included.
1849-50 .. .. .	2,031	1,356	675	50	0	0	0 Do. do. do. 22 3 8 do.
1850-51 .. .. .	6,313	4,543	1,770	90	0	0	0 Do. do. do. 72 15 10 do.
1851-52 .. .. .	10,640	7,906	2,734	75	0	0	0 Do. do. do. 584 7 0 do.
1852-53 .. .. .	11,288	5,031	6,257	159	0	0	0 Do. do. do. 1,252 15 2 and wastage of 25 6 5½ in Silver Refining Room, not included.
Average last 6 years..	40,890	26,663	14,227	93	0	0	0 Total value of drosses of Coining de- partments, of the 2nd period - 1,533 10 4 Do. of Refining Room, 20 14 8 Do. of Bullion or pre- melting Room, - 504 7 8 Total Losses not in- cluded, - 525 6 4 Excess in Bullion or pre-melting room, 2,967 14 6½ Total value of drosses of the 2nd period 2,059 0 8
Total and General average..	97,252	71,235	27,141	*77	1,124	*3	0 Total value of drosses of Coining de- partment, in 12 years - 2,440 13 10 Do. of Refining Room, 234 0 5 Do. of Bullion or pre- melting Room, - 625 13 1 Total Losses not in- cluded, for 12 years 2,167 1 1½ Excess in Bullion or pre-melting room, 3,599 8 6 Total value of drosses for 12 years 3,300 11 4
Deduct Losses.....			1,124	*3			
Net Gains.....			26,017	*74			
* Rate per lac on Total issues, viz., 351,76,239.							

\* Rate per lac on Total issues, viz., 351,78,239.

## APPENDIX No. 12.

FROM CAPTAIN JAMES H. BURKE,

*Mint Master.*

TO LIEUT. COL. J. T. SMITH,

*Mint Master, Madras.*

SIR,

I have the honor to transmit to you the accompanying paper, containing in juxtaposition replies to the enquiries embodied in your letter dated the 1st ultimo, No. 62.

2. I beg also to annex a Statement, shewing the results of the Pix Assays at the Royal Mint, of the Bombay Silver Coins of 1841 to 1852, both years inclusive.

3. With regard to the explanation requested towards the close of your letter under reply, respecting the absence of any recorded wastage in melting operations in this Mint in the years 1846-47 and 1847-48, I have the honor to inform you, that, a very considerable quantity of Merchants' Bullion and Government uncurrent coins was melted by the

\* There is no regular and separate pre-melting Department in this Mint, as yet, one will soon be established.

melter\* previous to receipt in 1846-47 and 1847-48, and the amount of silver extracted after the close of the official year from the melting pots used for running down the same, and

from the drosses, was more than sufficient to cover the ordinary operative losses in the meltings of standard silver during those years: hence instead of a loss, a gain was recorded as respects the melting operations embraced in that period.

The particular method by which this gain was derived was brought to the notice of Government by my Predecessor in the following terms.

“ This wastage† arises from the melting  
 † Falling on the Merchants and on the General Treasury.

“ of the Silver in Iron melting pots containing cavities capable of holding silver in a greater or less quantity, but occasionally to the extent of even three pounds or 96 Rupees worth, and as these pots cannot be broken up after each charge the silver imbedded in them, can only be recovered after they have been frequently used, and when it would be impossible to determine to whom the Silver found in them belonged, and it therefore becomes the property of Government.”

## APPENDIX No. 12.

It is right however I should inform you, that the practice out of which such gain as is above noticed would be derived, has been unequivocally condemned by the Honorable the Court of Directors.

I have &c.,

Your most obedient Servant,

(Signed) JAMES H. BURKE, CAPTAIN,

BOMBAY MINT, }  
18th September, 1854. }

*Mint Master.*

*Replies to the Queries contained in the letter from the Mint Master at Madras, dated the 1st August 1854, No. 62.*

<p>1. " It appears from a correspondence which took place in 1835 from a letter by Captain P. McGillivray, dated 11th November of that year, and a report by the Assay Master of the Calcutta Mint, Mr. James Prinsep dated 29th April 1836 that it was the practice at that time to pickle the Silver straps previous to finishing them, has that process been continued till now? And if not, when was it given up?"</p>	<p>The practice alluded to was abolished shortly after the date of Captain McGillivray's letter to which reference is made, because it entailed expense and loss of metal, and was of little ultimate advantage to the appearance of the Coin.</p>
<p>2. " In the same letter of Captain McGillivray it is stated, that an allowance was made by the Laminating Department to the Melting Department, on handing over Scissel, to compensate for oil adhering to it, and that this allowance amounted to 065 or 1 anna <math>\frac{3}{4}</math> pie per Cent. Did the same practice exist in any of the years from 1841-42 to 1852-53 inclusive, and if so, what was the average rate of allowance per Cent of the Bullion transferred in each year."</p>	<p>From 1841-42 to 1852-53 both years inclusive, the allowance granted by the Laminating to the Melting Department for oil adhering to Scissel, has uniformly been <math>7\frac{1}{8}</math> dwts. per 100 lbs. of Scissel or about <math>5\frac{1}{2}</math> pies per 100 Tolas; this amount of compensation was fixed in 1837, after a series of minute and carefully conducted experiments in this Mint.</p>
<p>3. " Were any other compensations made in transferring Bullion from one Department to another* in any of the above years and if so what were the average rates?"</p> <p>* Especially from Laminating to Milling or bleaching Departments.</p>	<p>No compensation is allowed to any of the other Departments of this Mint, on transferring Bullion from one to the other.</p>

(Signed) JAMES H. BURKE, CAPTAIN,

*Mint Master.*

## APPENDIX. No. 12.

*Abstract Statement shewing the results of the examination at the Royal Mint of the Silver Coins issued from the Bombay Mint from 1841 to 1852, both years inclusive.*

Description of Coins Pixed.	Years of Coinage.	WEIGHT.					QUALITY.				
		Above Standard.		Below Standard.		Grand Total.	Maximum deviation from the Standard weight.		Above Standard.	Below Standard.	Grand Total.
		Gr.	Gr.	Gr.	Gr.		Plus.	Minus.			
		Standard.				Total.			Dwts.	Dwts.	Total.
			Gr.	Gr.	Grs.				1	1	
Rupees.....	1841	11	1	3	1	5			16	0	16
Rupees.....	1842	10	2	0	2	2			8	0	8
Rupees.....	1842-43	7	0	1	6	7			16	2	18
Rupees.....	1844										
Rupees.....	1845	12	0	5	20	31			33	7	40
Rupees.....	1845-46	17	0	1	8	4			13	0	13
Half Rupees.....		2	0	0	4	4			4	1	5
Quarter Rupees.....		0	0	0	0	0			1	0	1
Two Anna Pieces		1	0	0	0	0			1	0	1
Rupees.....	1846-47	133	0	3	14	143			42	11	53
Rupees.....	1847-48	9	0	3	8	11			3	0	3
Rupees.....	1848-49	15	0	1	9	17			0	0	0
Rupees.....	1850										
Rupees.....	1851										
Rupees.....		6	0	23	28	57					
Half Rupees.....		0	0	2	4	6					
Quarter Rupees..		0	0	2	1	3					

*a* No report from the Royal Mint for the year 1844 is traceable either on the records of this Office or on that of the Mint Committee, it is presumed however that the report of the year 1845 comprised the Pix of the official year 1844-45 it having been the general practice previous to 1850 to forward to England for report the Pix of official years.

*b* The result of the examination of the *weight* of the Bombay coins pixed in 1850 was not communicated in the Royal Mint Report embracing that period. *c* Consequent on the altered arrangements introduced in 1850 for conducting business in the Royal Mint, the Pix coins issued from the British Indian Mints have from that year been reported decimally, instead of by half penny weights as was formerly the practice; hence a corresponding alteration in this return from 1850 to 1852 both years inclusive.

\* Exclusive of 1 reported 1½ dwt. below standard.

BOMBAY MINT, 18th September 1854.

Errors Excepted.

(Signed) JAMES, H. BURKE, CAPTAIN, Mint Master.



## APPENDIX No. 13.

No. 212 of 1854-55.

FROM

COL. W. N. FORBES, ENGINEERS,

*Mint Master.*

TO

LIEUT. COL. J. T. SMITH, ENGINEERS,

*Mint Master.*

SIR,

I have the honor to acknowledge the receipt of your letter of date the 1st instant, and in reply to state, that the Profits and Losses, exhibited in the Annual Abstract Statements of the losses, charges and profits in the Calcutta Mint, are the *actual differences* between the standard value of the metal delivered to, and received from each department, exclusive of “*compensation*” for dirt, oil, &c.

2. Care is taken to keep the Bullion, in process of coinage in the different departments, as free as possible from dirt, oil, &c., for which, in account, no “*compensation*” is, or can, *accurately*, be made.

3. The Pix Reports to which reference is made in the 3rd paragraph of your letter, being, it is believed, transmitted to the respective Mint Committees, will be obtainable by you *from that* of Madras.

I have the honor to be,

Sir,

Your most obedient Servant,

(Signed) W. N. FORBES,

*Mint Master.*

CALCUTTA MINT, }  
23rd August, 1854. }

## APPENDIX No. 14.

*Statement showing the fineness of Coins issued from the Madras Mint, as per Assay Master's pyx Reports for the twelve years from 1841-42 to 1852-53.*

Years.	Description of Coins.	B 1.	B ½.	Standard	W ½.	W 1.	Total	Value of Coins issued.		Better.	Worse.		Rate per lac of Coins issued.	
								C. Rs.	A.		C. Rs.	A.	Above Standard.	Below Standard.
1841-42	Single Rs....	54	171	864	207	18	1314	*027397						
1842-43	do. ...	8	72	336	12	0	428	17757						
	Quarter Rs...	15	82 5	92.5	7.5	0	197.5	.531645						
1843-44	Double As...	6.25	50	126.25	7.5	0	190	.289473						
	Single Rs....	0	104.75	1739.5	127	0	1971.25	.011287						
1844-45	Half do. ...	0	0	29.875	12.75	0	42.625	.299120						
	Quarter do...	0	1.34375	66.28125	5.375	0	73	.055222						
1845-46	Single do...	0	65	1290	100	0	1455	.024054						
	Half do...	0	0	5	1.25	0	6.25	.2						
1846-47	Quarter do...	0	1.4375	46	1.4375	0	48.875	.....						
	Double As...	0	3.625	92.34375	3.0625	0	99.03125	.005680						
1847-48	Single Rs....	4	100	460	8	0	572	.174825						
	Half do...	0	0	137.5	0	0	137.5	.....						
1848-49	Quarter do...	9.375	42	161.5625	4.1875	0	217.125	.260506						
	Double As...	0	18.84375	117.125	34.8125	0	170.78125	.098504						
1849-50	Single Rs....	21	272	2198.5	205.5	3	2700	.037962						
	Half do...	0	2.625	231	44.625	0	278.25	.150943						
1850-51	Quarter do...	0	5.5	33.1875	0	0	38.6875	.142164						
	Double As...	0	0	15.9375	1.6875	0	17.625	.095744						
3404								199,43,366	5	2457	0	73	12 5	1 0
										612	5	2 3	3 1	0 0
Results for the first period from 1841-42 to 1846-47								1,844	11	5	...	...	9	4
Deduct W ..														
.....Net B.....														

Year	Single Rs...	12.5	27.5	1302.5	100	2.5	1515	.011551	30,06,391	14 or 207 10	34,726 at B $\frac{1}{2}$	78 14	9 $\frac{1}{8}$	0	0	0	2 10	0	0	4
1847-48	Half do...	0	0	.125	0	0	.125	.....	2,43,873	7 or	1,263 at B $\frac{1}{2}$	2 13	11 $\frac{3}{8}$	0	0	0	0	0	0	0
	Quarter do...	2.5	6.875	100	11.25	0	120 625	.005181	2,44,827	13 or	15,554 at W $\frac{1}{2}$	78 3	7 $\frac{1}{8}$	0	0	35 5	7 $\frac{1}{8}$	0	0	0
	Double As...	10	1.3125	135.5625	10.6875	0	147.5625	.063532	11,60,441	12 or	34,419 at B $\frac{1}{2}$	6 13	8 $\frac{1}{8}$	0	0	0	6 11	10	0	14 7
1848-49	Single Rs...	10	37.5	502.5	40	0	590	.029661	99,624	13 or	3.018 at B $\frac{1}{2}$	78 3	7 $\frac{1}{8}$	0	0	0	6 11	10	0	1
	Quarter do...	0	4.5	42	3	0	49.5	.030303	36,609	10 or	1,230 at B $\frac{1}{2}$	2 12	8 $\frac{1}{8}$	0	0	0	7 10	0	0	0
	Double As...	0	.75	21.5625	0	0	22.3125	.033613	6,87,528	3 or	21,857 at B $\frac{1}{2}$	49 10	9 $\frac{1}{2}$	0	0	0	7 8	7	0	0
1849-50	Single Rs...	1	26	302	17	0	346	.031791	1,14,876	0 or	15,982 at B $\frac{1}{2}$	36 5	1 $\frac{3}{8}$	0	0	0	31 9	9	0	0
	Quarter do...	0	9	47.5	1	0	57.5	.139130	51,967	12		0	0	0	0	0	0	0	0	0
	Double As...	0	1	29	1	0	31	.....	15,38 115	5 or	37,854 at B $\frac{1}{2}$	86 0	6	0	0	0	5 9	5	0	0
1850-51	Single Rs...	5	80	616	71	0	772	.024611	2,18,836	5 or	34,973 at B $\frac{1}{2}$	79 7	3 $\frac{3}{8}$	0	0	0	36 5	1	0	0
	Quarter do...	5	18.5	89	1	.5	109.5	.159817	1,97,319	6 or	18,982 at B $\frac{1}{2}$	43 2	3	0	0	0	21 13	9	0	0
	Double As...	0	15.5	77.25	6	0	98.75	.096202	32,94,134	13 or	1,80,004 at W $\frac{1}{2}$	0	0	0	409	1	7 $\frac{1}{8}$	0	0	12 6
1851-52	Single Rs...	4	104	1176	168	12	1464	.054646	2,55,732	13 or	24,972 at W $\frac{1}{2}$	0	0	0	56 12	0	0	0	0	22 3
	Quarter do...	0	4.5	106.5	17	0	128	.097636	77,223	15 or	3,998 at W $\frac{1}{2}$	0	0	0	9	1	4 $\frac{1}{2}$	0	0	11 12
	Double As...	0	0	36.625	2	0	38.625	.051779	39,35,171	5 or	5,29,618 at W $\frac{1}{2}$	0	0	0	1,208	10	10	0	0	30 9
1852-53	Single Rs...	0	49	1606	314	0	1969	.134586	151,72,872	12		464	5	2 $\frac{1}{8}$	1,713	15	5 $\frac{1}{2}$	0	0	11 4
							9119	.0444			Deduct B....	0	0	0	464	5	2 $\frac{1}{8}$	0	0	3 0
												....	....	....	....	....	....	....	....	8 3

Results for the second period from 1847-48 to 1852-53.....Net W.....

\*.027397, Represents the fraction indicating the fineness of the issue. In this case  $\frac{4}{10}$ , (of  $\frac{1}{2}$  dwt.)

N. B.—When the number of Assays taken at different periods of time varies in reference to the value represented by them, it is necessary in order to admit of their being compared, or added together in the same calculation, that they be reduced to a uniform standard. For instance, if in one period an Assay were made for every 2,000 Tolals, and in the next the Assays were made for every 1,000 Tolals, it would be necessary that the latter number of Assays should be divided by 2, in order to make them correspond with the former.

In the above table all the assays have been reduced to conformity with the ratio of one assay for every 2,000 Tolas.

## APPENDIX No. 15.

*General Abstract Statement of the Losses and Charges and Profits in the Calcutta Mint,  
for the year 1852-53.*

	Gross weight Tolas,		Rate of Loss or Profit.		Loss or Profit Tolas,				
LOSSES.									
GOLD.									
Melted, Solid.....Tolas..	56,445	0 2							
Scissel..... do. ....	13,367	10 0	70,812	10 2	at 0.0. 1. 1235 per				
Loss by Gold Cornets stolen from the Assay Office .....			0 9 9		Cent. ....	4 1 10			
Loss by deficiency of weight in 754 Gold mohurs spoilt coin melted.....					Gold mohurs do. ....	0 10 4 0 1 6			
Gold Mohurs.. ..						4 13 2			
Rupees.. ..						72 6 6			
Loss by Tola 892 15 2 of fine Silver used as Alloy in the Alligation of Gold Value Rupees..						973 7 1			
Loss by Tola 893 3 0 of Copper used as Alloy value Rupees.....						9 2 4			
PROFITS.						1,054 15 11			
Gain by refinance charges on individual Bullion Tolas.....	5,304	11 8	Gold Mohurs		26 8 4				
Excess of loss written off in the melting department in April 1852.....			"		14 15 6				
Gain in the adjusting department....			"		2 7 2				
Gain by fractional differences in the Alligation of Gold.....			"		0 1 3				
Gold Mohurs.. ..					44 0 3				
Rupees.. ..						660 3 9			
No Gold Coinage this year. Total Loss on Gold operations Company's Rupees.....								394 12 2	
LOSSES.									
SILVER.									
Melted, Solid.....Tola..	3,15,84	404 0 9							
Scissel.....	2,62,71,219	15 0							
	5,78,55,623	15 9							
Laminated.....Tola..	5,53,40,920	2 0			Loss at 0 0 9.478 per ct. ....	28,560 3 4 *			
Carried forward..						28,560 3 4		394 12 2	

\* This is the Loss after deducting the Pot Cleanings Registered in November 1853 and belonging to the year 1852-53.



## APPENDIX No. 15.—(Continued.)

	Gross weight Tolas.	Rate of Loss or Profit.	Loss or Profit Tolas.			
Loss on Gold Operations Brought forward...					394	12 2
Loss on Silver Operations Brought forward...			28,560	3 4		
Cut for 180 Gr. Blanks Tolas 3,20,66,794 5 0						
Do. 90 do. do. ,, 8,42,866 6 0						
Do. 45 do. do. ,, 3,25,139 15 0						
Do. 22½ do. do. ,, 1,84,492 6 0						
Scissel returned..... ,, 2,24,09,087 4 9	5,58,29,280	4 9				
Adjusted.						
180 Gr. Blanks 25,14,000						
Tolas..... 25,15,571 4 0						
90 do. 36,000						
Tolas ..... 18,015 0 0						
45 do. 2,52,000						
Tolas..... 63,065 10 0	25,96,651	14 0				
		at 6 pie per Cent. ....	811	7 0		
Picked.						
180 Gr. Blanks 2,51,53,000						
Tolas..... 2,51,73,723 12 0						
90 do. 12,96,000						
Tolas..... 6,48,540 0 0						
45 do. 11,28,000						
Tolas..... 2,82,293 12 0						
22½ do. 12,04,000						
Tolas..... 1,50,664 9 9						
Spoilt whole Rupees 15,04,524						
half Rs. 84,019 Qr. Rs. 53,273.. 15,59,851 12 0	2,78,15,073	13 9				
		Decimal. at .351 of a pie per ct. ....	508	14 0		
Milled Annealed and Stamped.						
180 Gr. or whole Rupees.						
Tale 2,76,72,000.. Tolas.. 2,76,72,000 0 0	at 1 Anna per Cent. ....	17,293	0 0			
90 Gr. or half Rupees						
Tale 13,32,000..... Tolas.. 6,66,000 0 0	at 1 Anna 4 pie per Ct. ....	555	0 0			
45 Gr. or quarter Rs.						
Tale 13,80,000..... Tolas.. 3,45,000 0 0	at 1 Anna 8 pie per Ct. ....	359	6 0			
22½ Gr. or eighth Rs.						
Tale 12,04,000..... Tolas.. 1,50,500 0 0	at 1 Anna 9 pie per Ct. ....	164	9 9	18,373	15 9	
	2,88,33,500	0 0				
Loss by deficiency in the weight of 3,989 whole Rupees delivered to the Assay Office.				1	8 0	
Do. in Melting Tolas 1,80,257 6 0 of spoilt coins in the Assay Office.....				177	15 8	
Do. on Assaying 11,268 musters and sets of Assay Coins Tolas.....	25,333	4 1		373	11 6	
Carried forward Loss on Gold operations..						394 12 2
Carried forward Loss on Silver operations..				48,807	11 3	

## APPENDIX No. 15.—(Continued.)

	Gross weight Tolas.		Rate of Loss or Profit.	Loss or Profit Tolas.			
Loss on Gold Operations Brought forward....						394	12 2
Loss on Silver Operations Brought forward....				48,807	11 3		
Do on melting Tola weight 18,02,171 11 8 of Government Remittances at 0-4-0 .802 per Cent .....				4,580	12 0		
Do. on melting Tola weight 1,47,647 10 0 of understand spoil Coin Ingots .....				238	1 6		
Do. by the deficiency in the weight of 1,64,088 spoil Coins melted .....				39	6 0		
Do. in melting Tola weight 18,783 7 0 of Filings .....	at 1 8 0 per Cent.			281	12 0		
Deficiency of weight in 110 Assay Coins melted .....				0	12 0		
				53,948	6 9		
Value of Tolas 12,34,035 15 0 or Mun 385 25 7 of Copper used as Alloy in the Alligation of Silver Rupees .....				12,999	7 10		
Total Loss on Silver Rupees..				66,947	14 7		
PROFITS.							
Gain by unreported fractions of Assay on Tola weight .....	2,31,05,710	2 9	34,706	6 2			
Do. by refining charges on base Coins Tolas. 307	15 4		14	7 11			
Do. do. on individuals Silver Bullion Tolas. 8,967	7 8		37	4 0			
Do. do. on Coins crude Bullion received from Public Functionaries Tolas .....	12,133	2 0	118	7 3			
Gain on remelting melters over standard In- gots .....	Tola..90,437 8 0		390	3 9			
Do. by excess of weight on the re weigh- ment of private Nos. ....			10	1 5			
Do in the Laminating Department in La- minating .....	Tola..5,59,53,439 8 0		460	0 8			
Do by charges for melting Crude Bullion and foreign Coins remitted by public Func- tionaries Tola 9,16,057 14 3 at 1 per Mille.			916	0 10			
Fee for Silver Bullion withdrawn .....			10	0 0			
				36,663	0 0		
Loss on Coining Whole Rs. 2,62,21,460 Val. Rs. 2,62,21,460-0-0 Half Rs. 13,16,258 do. 6,58,129-0-0 Qr. Rs. 13,56,682 do. 3,39,165-8-0 Eighth Rs. 11,79,615 do. 1,47,451-14-0							
Tale..3,00,73,995 Value 2,73,66,206-6-0	at 0 1 9.247 per Cent. is Rupees...					30,284	14 7
Carried forward Total Gold and Silver Oper- ative losses Rs. ....						30,679	10 9

## APPENDIX No. 15.—(Continued.)

	Gross weight Tolas.		Rate of Loss or Profit.		Loss or Profit Tolas.			
Brought forward Total Gold and Silver operative Losses, Rupees.....							30,679	10 9
<b>CHARGES.</b>								
Total as per Monthly Accounts thereof.....	2,00,039	0 9						
From which deduct amount not chargeable to Coinage.....	37,267	7 10						
			1,62,771	8 11				
Charges actually incurred on account of Mint Establishment.....	1,10,466	4 7						
Do. do. extra do. do. ....	4,748	10 5						
Contingencies as detailed in Statement No. 5.	47,556	9 11						
			1,62,771	8 11				
Mint Master's Salary.....	33,078	0 0						
Assay Master's do. (Dr. James Dodd).....	18,873	10 10						
Officiating Assay Master's do. (Dr. W. B. O'Shanghnessy).....	1,382	10 0						
Do. do. (Dr. J. Shaw).....	5,409	9 0						
Officiating Dy. Assay Master's Salary and House rent (Dr. J. Shaw).....	4,642	14 3						
Foreman of the Assay Office and Officiating Asst. in charge (Mr. W. P. Davis).....	2,519	13 0						
Medical Attendant of the Mint.....	600	0 0						
Establishment of the Assay Office.....	3,120	14 1						
Mint Committee's Establishment and Contingencies.....	8,665	6 11						
Assessment Tax of the Mint.....	1,600	0 0						
Do. of the Assay Office.....	480	0 0						
Pension of Mr. A. Stewart (Mechanic).....	1,515	0 0						
Pension of five Natives.....	469	5 4						
Printing charges Military Orphan Press (Contingent).....	111	11 10						
			82,468	15 3				
					2,45,240	8 2		
<b>DUTY:</b>								
Received from Individuals duty on Gold Bullion Assay Value Gold mohurs 1,28,543 7 2 at 1 per Cent Gold mohurs.....			1,285	6 6				
Do. on Silver Bullion Assay Value Rupees.....			19,281	1 6				
Do. on Silver Bullion Assay Value Rupees..... 2,66,15,116 2 5 at 2 per Cent	5,32,301	14 6						
Do. do. 4,90,193 9 5 at 1 do. ....	4,901	14 8						
Do. do. duty free do. 43,670 11 0 at. ....	0	0 0						
Duty on Foreign Coins received from Collectors do. .... 9,04,077 6 5 at 2 per Cent.	18,081	8 6						
Do. on Crude Bullion from Public Functionaries. do. 12,061 6 1 at 2 per Cent.	241	3 7						
Duty on Sicca Rupees received by Collectors during the year 1351-52 as per Statement furnished by the Accountant to the Government of Bengal.....	2,324	14 7						
			5,57,851	7 10				
					5,77,132	9 4		
Net Profit on Silver Coinage Value Rupees 2,73,66,206 6 0 at 1 1 7 329 per Cent is Rupees.....							3,31,892	1 2
							3,01,212	6 5

## APPENDIX No. 15.

	Gross weight Tolas.		Rate of Loss or Profit.		Loss or Profit Tolas.	
<b>COPPER COINAGE.</b>						
Profit on Pyce after deducting cost of Copper.						
Indian Mun 5,097-20-10½ of Copper pro-	2,93,84,453					
duced Single Pyce.....	Value					
	4,59,132	1 3				
Do. cost of Copper .....	1,72,080	0 5	2,87,052	0 10		
Gain by difference on the Invoice weight of						
Copper Mun 6-9-11½ value Rupees.....			218	2 10		
Do. by Sale of Sulphate of Copper Mun						
50-3-2 sold for Rupees 870-6-0 Gain Rupees			445	8 9		
Do. by Sale of Copper Scissel Indian Mun						
2,400 sold for Rupees 86,228-4-9 Gain.....			5,013	3 6		
Do. by Surplus from the Assay Office.....			1	1 9		
					2,92,730	1 8
<b>DEDUCT,</b>						
Allowance to Licensed Potdars for issuing						
Pyce new Cos. Single 1,90,58,907, at 64 per						
Rupee .....	2,97,795	6 9				
Old do. 35,200.....	550	0 0				
Sicca Single 4,16,162.....	6,502	8 6				
	3,04,847	15 3				
Delivered to Potdars at 64½ per Rupee Value						
Rupees.....	3,02,485	0 0				
			2,362	15 3		
Loss by Sale of Mun 3,465-0-8½ of Copper						
Scissel sold for 1,14,473-12 losses.....			1,332	4 9		
Loss on Laminating and Cutting from						
May 1851 to June 1852 on Indian Mun						
15,292-12-7 at 5½ Chittacks per Mun is In-						
dian Mun 128-14-2½ at Rs. 3,34,378 per						
Mun is Rupees .....			4,291	14 2		
Loss by Sale of 120 Mun of Oxide of Copper						
sold for Rupees 2,055-5-0 loss.....			1,154	11 6		
Do. by Sale of old Cut Pyce 11,53,613 at						
64 per Rupees is.....	18,025	3 3				
Loss Weighing Indian Mun 180 sold at						
36.5258 per Mun.....	6,574	10 6				
Loss..			11,450	8 9		
					20,502	6 5
Net Profit on Coining 2,93,84,453 Single						
Pyce Value 4,59,132 1 3 at 59 4 4½ per						
Ct. is Rs.....						2,72,137 11 3
Net Profit on the Silver Copper Coinage						
(there being no Gold Coined this year)						
Value in Rupees 2,78,25,338 7 3 at 2 0 11						
.622 per Cent is Rupees.....						5,73,350 1 8

Errors Excepted.

(Signed) W. N. FORBES, *Mint Master.*

(True Copy)

(Signed) GEORGE COUPER.

*Offg. Secy. Mint Committee.*(A true Copy) (Signed) J. T. SMITH, *Mint Master.*CALCUTTA MINT, }  
24th December, 1853. }





## APPENDIX No. 17.

*Bombay Pyx Coins from 1841-42 to 1846-47.*

YEARS.	Description of Coins.	B 1.	B $\frac{1}{2}$ .	Stand-ard.	W $\frac{1}{2}$ .	W 1.	Total.	Value of Coins issued.	Better.	Worse.	Rate per Lac of Coins issued.	
								C. Rs. A.			Above standard.	Below standard.
1841-42	Single Rs....	0	24	28	22	0	74	* 027027				
1842-43	do. ....	2	16	6	1	0	25	.76				
1843-44	do. ....	None										
1844-45	do. ....	7	33	10	0	0	50	.94				
1845-46	do. ....	0	13	34	3	0	50	.2				
1846-47	do. ....	0	11	42	27	0	80	.2				
							279					
								517,38,939 14				
								Deduct Worse....				
								58,202 15 5				
								3,021 5 5				
								55,181 10 0				
								Net Better.....				
								Results for the first period from 1841-42 to 1846-47..				

*Pyx Coins from 47-48 to 51-52.*

YEARS.	Description of Coins.	B 1	B $\frac{1}{2}$ .	Stand-ard.	W $\frac{1}{2}$ .	W 1.	Total.	Value of Coins issued.	Better.	Worse.	Rate per Lac of Coins issued.	
								C. Rs. A.			Above Standard.	Below Standard.
1847-48	Single Rs....	0	3	13	17	6	39	.66666				
1848-49	do. ....	0	0	16	38	6	60	.83333				
1849-50	do. ....	0.9164					40	96,50,554 8				
1850-51	do. ....	0.91712					60	120,78,906				
1851-52	do. ....	0.91793					57	208,97,949				
							256	580,27,469 9				
								Deduct Worse...				
								34,774 11 9				
								30,380 5 10				
								511				
								Net Better.....				
								Results for the second period from 1847-48 to 1851-52..				

\* .027027.

Represents the fraction indicating the fineness of the issue. In this case  $\frac{2}{3}$  (of  $\frac{1}{2}$  dwt.)

† In these years the Outturn Value of the Coins has been calculated upon the Pyx of the Single Rupees, as the Value of the smaller Coins is no stated in the Accounts received from the Bombay Mint.

1854 to 10th January 1855.

Amount of  
Deduct  
delivered  
January  
ter, To  
and Sep

Difference  
lion con  
Net Exce

AND BLEACHING LOSSES ACCOUNTED FOR.

Copper, as above, 2,577

Excess ab  
Deduct re  
ment, m

*Milling, Bleaching, & Stamping.*

Net surplus  
plained

1,532 Loss of Copper.  
21 Silver in dross.  
484 Oxygen and dirt.

The extra  
and

Actual excess delivered,  
and accruing, in the La-  
minating, Cutting, and  
adjusting Departments.

2,037g

Total extr  
rent gain  
Add appar  
Do. Gain

ivered... 1,400  
er in dross. 35

Deduct ap  
Do.

Total i... 1,435

Result of

Copper.

- a* Vide Statement, actually experienced in the melting department. Vide Appendix No. 19.  
*b* At the rate of the Milling, Cleaning, and Stamping departments, comparing the gross weight  
*c* The loss of the department, with the weight of the finished coins and defective pieces delivered  
 bleaching weight of Silver bars recovered from the drosses.  
*d* In this calculation Appendix No. 23.  
 are Standard though it is not included above, because it is necessary to take it into account,  
 the value of apparent gains and losses which consisted of Copper. If it be wished to ascertain  
 fractions of the drosses, it will be necessary to add 29½ tolas to the results shown before (A)  
 retained in the drosses of all the coining departments. The total then becomes  
 tolas per lac.

## APPENDIX No. 18.

Statement of the results of work in the Madras Mint during the 23rd Settlement, viz., from 1st May 1854 to 10th January 1855.

## STANDARD WEIGHT.

Amount of Bullion operated on - - -	29,93,752	
Deduct Bullion remaining on hand, delivered to Mint Committee, 10th January 1855, and to the Assay Mas- ter, Tolas 1,516 in the Months of May and September 1854, - - - - -	8,86,208	
Difference, or Standard Weight of Bul- lion consumed, - - - - -	21,07,544	Coins delivered, - - - - - 21,10,149
Net Excess of Standard Silver. - - -	2,813	Excess of fineness above Standard 208
	21,10,357	True Standard weight of Coins delivered, - - - - - 21,10,357
	<u>Excess of Silver Analysed.</u>	
Excess above stated, - - - - -	2,813	
Deduct recoveries in pre-melting depart- ment, minus loss in weighing, &c. &c.,	223	
Net surplus by manipulation, to be ex- plained - - - - - A,	2,590	
	<u>Analysis of the Surplus by Manipulation.</u>	
The extra Copper used was 5253a—to cover and “Additional Alloy” proper.	2,676	Unreported Fractions. <sup>b</sup>
	2,577	To cover Loss of Copper in melting 1,046— and Bleaching, - - - - - 1,532 <sup>c</sup>
Total extra Copper, shewing the Appa- rent gain thereby, - - - - -	5,253 <sup>d</sup>	Total... 2,578
Add apparent Gain in Laminating, - -	1,400	
Do. Gain in fineness, included above, -	208	
	6,861	Total apparent gain.
Deduct apparent loss in melting, 2,234 <sup>f</sup>		
Do. do. do. bleaching, 2,037 <sup>g</sup>		
	4,271	
Result of surplus A above stated, - -	2,590	

## MELTING AND BLEACHING LOSSES ACCOUNTED FOR.

Additional Alloy, to meet Losses of Copper, as above, 2,577		
Melting.		Milling, Bleaching, & Stamping.
Loss of Copper..... 1,046		1,532 Loss of Copper. <sup>e</sup>
do. Silver in dross.... 237 <sup>h</sup>		21 Silver in dross. <sup>h</sup>
do. Oxygen and dirt, 951		484 Oxygen and dirt.
Total loss 2,234 <sup>f</sup>		2,037 <sup>g</sup>
Actual excess delivered, and accruing, in the La- minating, Cutting, and adjusting Departments.		
Delivered... 1,400		
Silver in dross. 35		
Total i... 1,435		

<sup>a</sup> Vide Statement of the Melters account, Appendix No. 19, where the additional Copper put into the pot is shown.

<sup>b</sup> At the rate of 127 tolas per lac of the issues by the mint (21,10,149) vide memorandum A, para 6.

<sup>c</sup> The loss of Copper in bleaching here stated, is the weight of solid metallic pure copper actually recovered from the bleaching liquid.

<sup>d</sup> In this calculation, the quantity of Copper absorbed by the unreported fractions is taken on the supposition that the coins are Standard; but by the result of the Assay Master's pyx assays, the actual fineness of all the coins is such, as to raise the value of the entire deliveries to 208\* Rupees above Standard. From this it would appear that the unreported fractions are 10 Rupees more than 127 tolas per lac.

\* Vide Appendix No. 20.

<sup>e</sup> Vide remark above note c regarding the Copper.

<sup>f</sup> This is the amount of gross, or apparent loss, actually experienced in the melting department. Vide Appendix No. 19.

<sup>g</sup> This is the actual aggregate deficiency in the Milling, Cleaning, and Stamping departments, comparing the gross weight of blanks received from the Laminating department, with the weight of the finished coins and defective pieces delivered to the Mint Treasury, and the Standard weight of Silver bars recovered from the drosses.

<sup>h</sup> Vide Assay Master's Report of the drosses Appendix No. 23.

<sup>i</sup> The value in the dross is included here, although it is not included above, because it is necessary to take it into account, in order to get the true portion of the apparent gains and losses which consisted of Copper. If it be wished to ascertain the total surplus deliveries inclusive of the drosses, it will be necessary to add 294 tolas to the results shown before (A) that being the value of the silver contained in the drosses of all the coining departments. The total then becomes 2590+294, or 2884—at the rate of 137 tolas per lac.



## Silver Melting Room account for the 23rd Settlement, viz., from May 1854 to 10th January 1855.

Cr.

Dr.

	Gross weight.			Standard weight.			Standard weight as per Office Books.				Gross weight.			Standard weight.			Standard weight as per Office Book.		
	Tolas.	A.	P.	Tolas.	A.	P.	Tolas.	A.	P.		Tolas.	A.	P.	Tolas.	A.	P.	Tolas.	A.	P.
To Amount of Silver Bullion.....	18,74,770	5	4	19,20,398	0	8 $\frac{3}{4}$	19,20,398	0	8 $\frac{3}{4}$	By Amount of Standard Ingots.....	30,43,473	0	0	30,43,473	0	0	30,43,473	0	0
To do. of Standard Scissel.....	14,56,325	6	0	14,56,325	6	0	14,56,325	6	0	By do. of W $\frac{1}{2}$ do. ....	9,75,969	1	0	9,73,750	15	2 $\frac{3}{4}$	9,75,969	1	0
To do. of W $\frac{1}{2}$ Scissel.....	4,87,743	14	0	4,86,635	5	10 $\frac{3}{4}$	4,87,743	14	0	By do. of Bars, &c. do. ....	15,581	5	0	16,354	7	8 $\frac{1}{4}$	16,354	7	8 $\frac{1}{4}$
To do. of B $\frac{1}{2}$ Ingots.....	47,790	0	0	47,898	9	9 $\frac{3}{4}$	47,790	0	0	By do. of duplicate musters.....	1,532	0	0	1,562	11	1 $\frac{3}{4}$	1,562	11	1 $\frac{3}{4}$
To do. of Standard Ingots.....	21,330	7	0	21,330	7	0	21,330	7	0										
To do. of W $\frac{1}{2}$ Ingots.....	72,227	11	0	72,063	8	6 $\frac{1}{2}$	72,227	11	0										
To do. of Standard laminated Straps.	20,562	3	0	20,562	3	0	20,562	3	0										
To do. of Silver melting Room Dross																			
Bars received back from Mint Treasury.	7,348	3	0	7,963	9	0 $\frac{1}{2}$	7,963	9	0 $\frac{1}{2}$	Deduct the loss in 6 refined Bars worked up in the Melting Room and 2 delivered at the close of the Settlement.....	40,36,555	6	0	40,35,141	2	0 $\frac{1}{2}$	40,37,359	3	9 $\frac{7}{8}$
Copper.....	51,489	9	10 $\frac{1}{4}$							Nos. 5493, 5710, 5711 } 5 Bars wg 5605 7-0 B. 18 458-10-0 $\frac{1}{2}$									
40,39,587 11 2 $\frac{1}{2}$ Gross weight of bullion melted										5862 & 6064 } 1 do. ,, 1286 6-0 B. 19 $\frac{1}{2}$ 114 - 0-3 $\frac{1}{2}$									
40,33,177 1 11 $\frac{3}{8}$ Standard weight of do. do.										5824..... 1 do. ,, 1186 7-0 B. 19 102 - 7-5 $\frac{1}{2}$									
6,410 9 2 $\frac{3}{8}$ Deduct worseness of Scissel and ingots.										6272..... 1 do. ,, 1584 15-0 B. 17 122 - 7-0 $\frac{1}{2}$									
1,164 0 9 $\frac{3}{8}$										8 9663 3-0									
5,246 8 5 Deduct Copper lost from refined bars.																			
797 9 3 $\frac{7}{8}$																			
4,448 15 1 $\frac{1}{8}$ Deduct Copper deficient in remaining musters and bars.																			
803 13 9 $\frac{3}{8}$																			
5,252 12 11 } Deduct Copper beyond Standard left in the Coins at the rate of 249 tolas per lac of issues by the Mint.																			
Excess.....				1,964	0	5 $\frac{5}{8}$	3,018	1	0 $\frac{5}{8}$	Gross Loss...	2,234	11	10 $\frac{3}{8}$						
Total.....	40,39,587	11	2 $\frac{1}{2}$	40,35,141	2	0 $\frac{1}{2}$	40,37,359	3	0 $\frac{5}{8}$	Total.....	40,39,587	11	2 $\frac{1}{2}$	40,35,141	2	0 $\frac{1}{2}$	40,37,359	3	9 $\frac{7}{8}$

Remelted 1,73,893-11-0 making the total meltings 42,13,481-6-2 $\frac{1}{2}$  having a loss of 2234-11-10 $\frac{3}{8}$  at the rate of 8 Annas 5 $\frac{1}{2}$  Pice per mille.

## APPENDIX No. 20.

Statement, shewing the Number of Pix Assays made during the 23d Settlement, viz., from 1st May 1854 to 10th January 1855, with the calculated fineness of the Coins thereupon.

Description of Coins.	B 1.	B $\frac{1}{2}$ .	Standard.	W $\frac{1}{2}$ .	Total.		Value of Coins issued.				Better.			Worse.		
							Tolas.				Tolas.			Tolas.		
Single Rupees.....	7	74	801	45	927	*.046386	18,48,890	10	0	or 85,762 at B $\frac{1}{2}$ .....	194	14	7 $\frac{3}{8}$	0	0	0
Quarter do.....	0	10	244	16	270	.022222	1,35,306	4	0	or 3,006 at W $\frac{1}{2}$ .....	0	0	0	6	13	3 $\frac{5}{8}$
Double Annas.....	0	40	460	4	504	.071428	1,25,952	9	0	or 8,996 at B $\frac{1}{2}$ .....	20	7	1 $\frac{1}{2}$	0	0	0
											215	5	8 $\frac{7}{8}$	6	13	3 $\frac{5}{8}$
										Deduct Worse...	6	13	3 $\frac{5}{8}$			
										Net Better.....	208	8	5 $\frac{1}{4}$			

\* .046386 Represents the fraction indicating the fineness of the issue. In this case  $\frac{49}{107}$  (of  $\frac{1}{2}$  dwt.)

*to 10th January 1855.*

Cr.

	Gross weight.			Standard weight.			Standard weight as per Office Book.		
	Tolas.	A.	P.	Tolas.	A.	P.	Tolas.	A.	P.
Ingot.....	30,43,473	0	0	30,43,473	0	0	30,43,473	0	0
do. ....	9,75,969	1	0	9,73,750	15	$2\frac{5}{8}$	9,75,969	1	0
do. ....	15,581	5	0	16,354	7	$8\frac{1}{8}$	16,354	7	$8\frac{1}{8}$
musters.....	1,532	0	0	1,562	11	$1\frac{3}{4}$	1,562	11	$1\frac{3}{4}$
	40,36,555	6	0	40,35,141	2	$0\frac{1}{2}$	40,37,359	3	$9\frac{7}{8}$
Refined Bars worked down and 2 delivered to Government.....									
5 5605 7-0 B. 18 458-10- $0\frac{1}{4}$									
1286 6-0 B. 19 $\frac{1}{2}$ 114 - 0- $3\frac{3}{8}$									
1186 7-0 B. 19 102 - 7- $5\frac{1}{4}$									
1584 15-0 B. 17 122 - 7- $0\frac{5}{8}$									
	797	9	$3\frac{7}{8}$						
9663 3-0	40,37,352	15	$3\frac{7}{8}$						
Gross Loss....	2,234	11	$10\frac{3}{8}$						
Total.....	40,39,587	11	$2\frac{1}{4}$	40,35,141	2	$0\frac{1}{2}$	40,37,359	3	$9\frac{7}{8}$

at the rate of 8 Annas  $5\frac{3}{4}$  Pice per mille.

January 1855, with the calculated fineness of the Coins thereupon.

	Better.			Worse.		
at $B\frac{1}{2}$ .....	194	14	$7\frac{3}{8}$	0	0	0
at $W\frac{1}{2}$ .....	0	0	0	6	13	$3\frac{5}{8}$
at $B\frac{1}{2}$ .....	20	7	$1\frac{1}{2}$	0	0	0
	<u>215</u>	<u>5</u>	<u><math>8\frac{7}{8}</math></u>	<u>6</u>	<u>13</u>	<u><math>3\frac{5}{8}</math></u>
Deduct Worse...	6	13	$3\frac{5}{8}$			
Net Better.....	208	8	$5\frac{1}{4}$			

3c  $\frac{43}{827}$  (of  $\frac{1}{2}$  dwt.)

## APPENDIX No. 21.

Statement, showing the course of work in the Laminating Department, for the Month of September 1884, and the influence of each Process upon the weight of the Silver subjected to its Operation.

Date.	Roughing Mill.				1st.				2nd.				3rd.				Finishing Mill.				Disk Cutting.				Sorting and Blank Cutting.		Result.	REMARKS.
	Weight before.		Minus.		Feet.	Plus.	Weight before.	Feet.	Weight before.	Plus.	Weight before.	Feet.	Weight before.	Plus.	Weight before.	Minus.	Weight before.	Minus.	Weight before.	Plus.	Weight before.	Minus.						
1	24,377	0.8	.....	.....	300	29,498	2.3	.....	500	24,376	5.13	.....	.....	.....	31,730	0.0	35,476	2.2	19,080	0.11	.....	.....	4.11					
2	62,466	2.9	174	28,039	1.8	290	28,061	4.6	700	34,401	6.10	.....	.....	.....	12,284	0.0	24,950	0.10	18,443	0.4	.....	.....	9.1					
3	46,802	1.2	180	28,733	1.14	.....	.....	.....	580	28,048	5.11	.....	.....	.....	29,439	0.0	38,725	1.5	18,950	0.11	.....	.....	4.7					
4	52,969	1.3	90	14,300	0.3	300	28,733	4.10	300	14,433	3.7	.....	.....	.....	20,739	0.11	27,226	0.4	22,819	0.15	.....	.....	5.3					
5	21,470	1.3	90	14,369	0.8	300	28,667	2.12	600	28,600	5.14	.....	.....	.....	21,587	0.8	11,182	1.1	15,207	0.3	.....	.....	6.3					
6	49,957	2.7	270	42,785	2.10	.....	.....	.....	300	14,366	3.8	.....	.....	.....	28,639	1.12	29,085	0.3	20,324	0.2	.....	.....	1.10					
7	21,183	0.10	.....	.....	450	42,785	4.7	.....	600	28,636	6.0	.....	.....	.....	28,562	0.7	19,576	0.8	18,868	0.12	.....	.....	8.2					
8	47,961	2.10	.....	40,877	1.12	300	28,919	4.10	300	14,151	2.12	.....	.....	.....	28,417	0.5	25,523	0.7	24,403	0.3	.....	.....	5.9					
9	69,254	2.9	180	28,780	1.11	275	26,525	3.0	850	40,881	8.12	.....	.....	.....	21,474	1.5	13,756	0.9	20,266	0.7	.....	.....	8.9					
10	57,933	1.13	177	28,513	0.15	295	28,184	3.7	300	14,569	2.12	.....	.....	.....	31,628	0.7	24,158	0.10	23,656	1.5	.....	.....	2.15					
11	50,101	1.10	180	28,929	2.6	295	29,148	1.8	300	42,730	9.6	.....	.....	.....	21,709	0.10	26,056	0.12	29,419	0.12	.....	.....	9.8					
12	38,617	2.3	180	28,926	2.9	300	28,642	2.9	300	14,603	3.5	.....	.....	.....	28,714	0.3	29,921	0.11	30,246	0.13	.....	.....	4.9					
13	28,288	1.6	90	13,974	2.2	150	14,614	1.12	900	43,251	7.3	.....	.....	.....	9,277	0.1	9,146	0.7	23,753	1.3	.....	.....	8.0					
14	57,133	0.4	180	28,778	0.13	150	13,973	2.15	.....	.....	.....	.....	.....	.....	28,577	0.4	28,140	0.0	22,892	0.0	.....	.....	3.4					
15	28,350	1.9	90	14,382	0.13	450	43,160	3.15	600	28,377	4.9	.....	.....	.....	28,654	0.1	25,367	0.14	22,964	0.8	.....	.....	5.5					
16	33,565	0.11	90	14,358	.....	.....	.....	.....	600	28,756	5.5	.....	.....	.....	9,619	0.2	10,338	0.0	19,584	0.1	.....	.....	6.1					
17	42,211	0.7	180	27,852	1.11	150	14,358	1.1	.....	.....	.....	.....	.....	.....	28,692	0.2	37,910	0.14	25,872	0.11	.....	.....	2.10					
18	41,878	0.11	180	28,152	2.8	300	27,853	2.8	600	28,488	6.9	.....	.....	.....	.....	.....	.....	.....	14,024	0.0	.....	.....	11.14					
19	49,018	2.11	90	14,009	1.8	300	28,152	3.12	300	13,727	3.13	.....	.....	.....	28,691	0.5	24,700	0.0	13,942	0.5	.....	.....	5.12					
20	49,390	2.12	180	28,389	2.12	300	14,011	2.12	600	28,153	5.7	.....	.....	.....	27,779	0.7	20,818	0.6	18,863	0.5	.....	.....	7.1					
21	42,353	0.3	90	14,092	1.4	300	28,391	3.11	300	14,011	3.1	.....	.....	.....	9,548	0.3	8,739	0.14	16,251	0.1	.....	.....	6.11					
22	58,587	1.9	39	6,369	0.4	150	14,092	2.5	600	28,393	5.12	.....	.....	.....	30,242	0.2	28,134	0.2	18,301	0.0	.....	.....	6.8					
23	39,073	0.6	128	31,455	2.5	220	16,099	2.1	300	14,093	3.8	.....	.....	.....	11	Inch ingots	17,994	0.0	26,271	0.0	.....	.....	6.9					
24	48,502	0.14	.....	.....	.....	225	21,426	2.15	130	6,370	0.14	.....	.....	.....	25,980	0.6	25,978	0.11	20,372	0.15	.....	.....	2.2					
do.	.....	.....	105	10,974	1.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....				
.....	10,61,443	33.14	3,218	5,16,755	34.13	5,800	5,35,291	66.3	11,160	5,33,413	109.15	5,41,478	9.4	5,42,898	14.6	5,04,770	11.3	142.3	.....	.....	.....	.....	.....	.....				

Total Plus 210.15 Total Minus 68.11 Weight of Bullion worked 6,15,686 Tolas.

## APPENDIX No. 22.

*Bombay Mint, 28th January, 1834.*

Present the Mint Master and Assay Master and the Mint Engineer and Assistant.

Made the following trials of the loss in annealing and breaking down Ingots to 210. N. B.—A skin placed under the rolls and (from 2nd to 5th) cloth in the carts, to catch the dust and small fragments of silver.

## No. 1.

	<i>lbs. oz. dwt.</i>
31½ Bars which had been previously annealed with charcoal, weighed before Rolling.....	545 9 15
After Rolling (N. B. dust accidentally thrown out, but all small particles of silver weighed with the slips.)	
Loss.....	0 1 10

## No. 2.

31 Bars and 12 Pieces (delivered 27th) of ordinary description, being chiefly such as had been rejected in consequence of flawed parts required to be cut off, and therefore likely to show greater loss than average bars, weight before annealing in the annealing Furnace.....	599 6 0
After annealing, cooled gradually and well rubbed with a cloth.	
Loss.....	0 2 10
Rolled, no further loss apparent—on the contrary there were 4½ dwts. of small pieces and metallic dust not weighed with the slips.	

## No. 3.

35 Bars (delivered 25th) good average bars weighed before Rolling.....	604 4 0
Rolled without annealing—after Rolling Loss..	0 1 15
Small fragments and metallic dust dwts 12 5½ grs. weighed with the slips.	

## No. 4.

	<i>lbs. oz. dwt.</i>
31 Bars and 2 pieces good bars, annealed as in No. 1 weight before Rolling.....	550 11 10
After rolling including dust and Scraps. Loss ...	0 1 2½



The Assay Master having left the Rolling Mill. Assistant Assay Master present at the weighing.

## No. 5.

35 Bars fair average bars (delivered 25th) weight  
before annealing..... 593 10 15  
After annealing the in Furnace being wiped with  
a cloth.

Loss..... 0 0 15

After Rolling including dust and Scrap.

Further Loss..... 0 2 0

(Signed) JAMES FARISH,

*Mint Master.*

„ F. MCGILLEVERY,

*Mint Engineer.*

(True Copy.)

J. T. SMITH.

*Mint Master.*

## APPENDIX No. 23.

*Assay and Outturn Report on 12 Musters of Drosses of the 23rd Settlement, received from the Mint Master on the 9th January 1855.*

Quantity of Dross taken for Assay.	Description of Dross.	Gross Weight of Silver recovered after deducting $1\frac{1}{2}$ Grains found in the Li-charge.		Fineness after Cupellation in the regular way	Total weight of the Dross.	Value.		
		Gr.	Dec.	Dwts.	Tolas.	Rs.	A.	P.
	<i>Silver Melting Room.</i>							
100	.....No. 1	1	.47	B 19 $\frac{1}{2}$	9,800	0	13	10
100	.....2	2	.83	B 19 $\frac{1}{2}$	1,48,000	25	5	2
100	.....3	2	.50	B 19 $\frac{1}{2}$	1,47,000	22	3	7
100	.....4	8	.47	B 19 $\frac{1}{2}$	3,70,000	189	8	6
	<i>Private Bullion Melting Room.</i>							
100	.....No. 1	8	.88	B 19 $\frac{1}{2}$	1,10,095	59	2	0
100	.....2	8	.25	B 19 $\frac{1}{2}$	10,906	5	7	0
	<i>Public Bullion Melting Room.</i>							
100	.....No. 1	8	.97	B 19 $\frac{1}{2}$	10,069	5	7	4
100	.....2	9	.21	B 19 $\frac{1}{2}$	1,010	0	8	11
	<i>Laminating Room.</i>							
100	.....No. 2	5	.70	B 19 $\frac{1}{2}$	2,022	0	11	0
100	.....3	9	.33	B 19 $\frac{1}{2}$	18,237	10	4	6
100	.....4	20	.52	B 19 $\frac{1}{2}$	19,703	24	7	2
	<i>Milling, Cleaning and Stamping Rooms.</i>							
100	.....No. 1	12	.59	B 19 $\frac{1}{2}$	28,000	21	5	1
Total Dross Value...						365	4	1
Deduct Private and Public Bullion Melting Room Drosses, not connected with Coinage.....						70	9	3
Value of the Coinage Drosses....						294	10	10

(Signed) G. J. SHAW,  
Assay Master.

FORT ST. GEORGE, Assay Office, }  
5th February 1855.

To the Mint Master,

Fort St. George:

(A. True Copy.)

J. T. SMITH,  
Mint Master.

## APPENDIX No. 24.

*Table showing the Correspondence between the Rates per Lac, per Mille, and per cent. in Rupees Annas and Pice.*

Rate per Lac.	Equivalent per Mille.			Equivalent per Cent.			Rate per Lac.	Equivalent per Mille.			Equivalent per Cent.			Rate per Lac.	Equivalent per Mille.			Equivalent per Cent.		
	R.	A.	P.	R.	A.	P.		R.	R.	A.	P.	R.	R.		A.	P.	R.	A.	P.	
1	0	0	1.92	0	0	0.192	51	0	8	1.92	0	0	9.792	101	1	0	1.92	0	1	7.392
2	0	0	3.84	0	0	0.384	52	0	8	3.84	0	0	9.984	102	1	0	3.84	0	1	7.584
3	0	0	5.76	0	0	0.576	53	0	8	5.76	0	0	10.176	103	1	0	5.76	0	1	7.776
4	0	0	7.68	0	0	0.768	54	0	8	7.68	0	0	10.368	104	1	0	7.68	0	1	7.968
5	0	0	9.60	0	0	0.960	55	0	8	9.60	0	0	10.560	105	1	0	9.60	0	1	8.160
6	0	0	11.52	0	0	1.152	56	0	8	11.52	0	0	10.752	106	1	0	11.52	0	1	8.352
7	0	1	1.44	0	0	1.344	57	0	9	1.44	0	0	10.944	107	1	1	1.44	0	1	8.544
8	0	1	3.36	0	0	1.536	58	0	9	3.36	0	0	11.136	108	1	1	3.36	0	1	8.736
9	0	1	5.28	0	0	1.728	59	0	9	5.28	0	0	11.328	109	1	1	5.28	0	1	8.928
10	0	1	7.20	0	0	1.920	60	0	9	7.20	0	0	11.520	110	1	1	7.20	0	1	9.120
11	0	1	9.12	0	0	2.112	61	0	9	9.12	0	0	11.712	111	1	1	9.12	0	1	9.312
12	0	1	11.04	0	0	2.304	62	0	9	11.04	0	0	11.904	112	1	1	11.04	0	1	9.504
13	0	2	0.96	0	0	2.496	63	0	10	0.96	0	1	0.096	113	1	2	0.96	0	1	9.696
14	0	2	2.88	0	0	2.688	64	0	10	2.88	0	1	0.288	114	1	2	2.88	0	1	9.888
15	0	2	4.80	0	0	2.880	65	0	10	4.80	0	1	0.480	115	1	2	4.80	0	1	10.080
16	0	2	6.72	0	0	3.072	66	0	10	6.72	0	1	0.672	116	1	2	6.72	0	1	10.272
17	0	2	8.64	0	0	3.264	67	0	10	8.64	0	1	0.864	117	1	2	8.64	0	1	10.464
18	0	2	10.56	0	0	3.456	68	0	10	10.56	0	1	1.056	118	1	2	10.56	0	1	10.656
19	0	3	0.48	0	0	3.648	69	0	11	0.48	0	1	1.248	119	1	3	0.48	0	1	10.848
20	0	3	2.40	0	0	3.840	70	0	11	2.40	0	1	1.440	120	1	3	2.40	0	1	11.040
21	0	3	4.32	0	0	4.032	71	0	11	4.32	0	1	1.632	121	1	3	4.32	0	1	11.232
22	0	3	6.24	0	0	4.224	72	0	11	6.24	0	1	1.824	122	1	3	6.24	0	1	11.424
23	0	3	8.16	0	0	4.416	73	0	11	8.16	0	1	2.016	123	1	3	8.16	0	1	11.616
24	0	3	10.08	0	0	4.608	74	0	11	10.08	0	1	2.208	124	1	3	10.08	0	1	11.808
25	0	4	0.00	0	0	4.800	75	0	12	0.00	0	1	2.400	125	1	4	0.00	2	0	0.000
26	0	4	1.92	0	0	4.992	76	0	12	1.92	0	1	2.592	126	1	4	1.92	0	2	0.192
27	0	4	3.84	0	0	5.184	77	0	12	3.84	0	1	2.784	127	1	4	3.84	0	2	0.384
28	0	4	5.76	0	0	5.376	78	0	12	5.76	0	1	2.976	128	1	4	5.76	0	2	0.576
29	0	4	7.68	0	0	5.568	79	0	12	7.68	0	1	3.168	129	1	4	7.68	0	2	0.768
30	0	4	9.60	0	0	5.760	80	0	12	9.60	0	1	3.360	130	1	4	9.60	0	2	0.960
31	0	4	11.52	0	0	5.952	81	0	12	11.52	0	1	3.552	131	1	4	11.52	0	2	1.152
32	0	5	1.44	0	0	6.144	82	0	13	1.44	0	1	3.744	132	1	5	1.44	0	2	1.344
33	0	5	3.36	0	0	6.336	83	0	13	3.36	0	1	3.936	133	1	5	3.36	0	2	1.536
34	0	5	5.28	0	0	6.528	84	0	13	5.28	0	1	4.128	134	1	5	5.28	0	2	1.728
35	0	5	7.20	0	0	6.720	85	0	13	7.20	0	1	4.320	135	1	5	7.20	0	2	1.920
36	0	5	9.12	0	0	6.912	86	0	13	9.12	0	1	4.512	136	1	5	9.12	0	2	2.112
37	0	5	11.04	0	0	7.104	87	0	13	11.04	0	1	4.704	137	1	5	11.04	0	2	2.304
38	0	6	0.96	0	0	7.296	88	0	14	0.96	0	1	4.896	138	1	6	0.96	0	2	2.496
39	0	6	2.88	0	0	7.488	89	0	14	2.88	0	1	5.088	139	1	6	2.88	0	2	2.688
40	0	6	4.80	0	0	7.680	90	0	14	4.80	0	1	5.280	140	1	6	4.80	0	2	2.880
41	0	6	6.72	0	0	7.872	91	0	14	6.72	0	1	5.472	141	1	6	6.72	0	2	3.072
42	0	6	8.64	0	0	8.064	92	0	14	8.64	0	1	5.664	142	1	6	8.64	0	2	3.264
43	0	6	10.56	0	0	8.256	93	0	14	10.56	0	1	5.856	143	1	6	10.56	0	2	3.456
44	0	7	0.48	0	0	8.448	94	0	15	0.48	0	1	6.048	144	1	7	0.48	0	2	3.648
45	0	7	2.40	0	0	8.640	95	0	15	2.40	0	1	6.240	145	1	7	2.40	0	2	3.840
46	0	7	4.32	0	0	8.832	96	0	15	4.32	0	1	6.432	146	1	7	4.32	0	2	4.032
47	0	7	6.24	0	0	9.024	97	0	15	6.24	0	1	6.624	147	1	7	6.24	0	2	4.224
48	0	7	8.16	0	0	9.216	98	0	15	8.16	0	1	6.816	148	1	7	8.16	0	2	4.416
49	0	7	10.08	0	0	9.408	99	0	15	10.08	0	1	7.008	149	1	7	10.08	0	2	4.608
50	0	8	0.00	0	0	9.600	100	1	0	0.00	0	1	7.200	150	1	8	0.00	0	2	4.800





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